List of open electives offered by Chemical Engineering Department (R-19 regulations)

CHE 311 Open Elective - I

CHE 311(A)	Food Processing Technology
CHE 311(B)	Engineering Biology
CHE 311(C)	Fuel Cell Technology
CHE 311(D)	Design of experiments

CHE 321 Open Elective - II

CHE 321(A)	Fundamentals of Industrial Safety and Health
CHE 321(B)	Bioinformatics
CHE 321(C)	Corrosion Engineering
CHE 321(D)	Computational tool for Engineers

Open Elective-I

Food Processing Technology

Course Code – Category: CHE 311 (A) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Basic Biology, Basic Chemistry

Course Objectives:

- To understand the fundamentals of food processing
- To have an awareness of various unit operations in food industry
- To know about the various handling and storage techniques of various foods

Course Outcomes:

By the end of the course, student will be able to

1. Relate the microbiology and biochemistry to food technology.
2. Apply the suitable mechanical operation technique in food industry.
3. Apply the principles of unit processes in food processing.
4. Identify the production of various food products
5. Identify the various handling techniques in food industry.

CO – PO – PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1														
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SYLLABUS

UNIT I **9L + 3T**

Food Microbiology & Biochemistry: General aspects of food industry, introduction to food microorganisms, association with food, sources and behaviour of food, factors affecting

microbial growth and decay, thermal death kinetics, carbohydrates, proteins, lipids,vitamins-sources, nutrition value of food.

Learning Outcomes:

At the end of this unit, student will be able to

- Analyze the importance of microorganisms and factors affecting the microbial growth and decay.
- Analyze the nutrition value of food.

UNIT II **9L + 3T**

Food Processing Operations-I:

Characteristics, cleaning sorting, and grading of food raw materials, size reduction, size enlargement, mixing, emulsification, filtration, centrifugation.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply the grading techniques for food raw materials.
- Apply the various mechanical operations for food processing.

UNIT III **9L + 3T**

Food Processing Operations-II:

Extraction, crystallization, drying, lyophilisation, microwave heating.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply extraction and crystallization techniques in food industry.
- Apply drying and lyophilisation techniques in food industry.

UNIT IV **9L + 3T**

Production of Food Products:

Industrial production of beverages, non beverages products, dairy products, bakery, confectionery products and processing of vegetables, fruits and animal products.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the manufacturing techniques for production of beverages and dairy products.
- Identify the processing techniques for vegetables, fruits and animal products .

UNIT V **9L + 3T**

Handling, Packaging and Storage of Food Products:

Food spoilage, food quality control, characteristics of packaging materials, manufacture of plastic films, coils, laminates, pouches, rigid plastic container paper, corrugated paper boards, shipping cartoons and containers.

Learning Outcomes:

At the end of this unit, student will be able to

- Analyze the sources of food spoilage and food quality control.
- Apply the suitable manufacturing technique for production of packaging cartoons and containers.

Text books:

1. Dennis. R. Heldmann., *Food Processing Engineering*, 3rd edition, Springer
2. D.G.Rao., Fundamentals of food engineering, 2002, PHI Learning Private Ltd

Reference book:

1. Michele Marcotte, Hosahalli Ramswamy, *Food Processing principles and applications*, 2005, CRC press
2. Gordon. L. Robertson, *Food Packaging : Principles and Practice*, 2006, CRC press

Open Elective-I

Engineering Biology

Course Code – Category: CHE 311 (B) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Nil

Course Objectives:

- To inculcate the fundamentals of life sciences with engineering application
- To write mathematical models for antigen-antibody interactions
- To predict infection by mathematical modelling.

Course Outcomes:

By the end of the course, student will be able to

1. Apply the mathematics techniques to the growth of microorganims.
2. Identify the structure and properties of biomolecules
3. Model the antigen-antibody interactions
4. Formulate the mechanism of enzyme- substrate kinetics
5. Model the mechanism of disease

CO – PO – PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1														
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UNIT I **9L + 3T**

Introduction to Microbiology:

Phylogeny of the three dimensions of life, ultra structure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell, counting of microorganisms, sterilization, microbial growth kinetics,

Learning Outcomes:

At the end of this unit, student will be able to

- Analyze the micro structure of living organisms.
- Model the growth kinetics.

UNIT II **9L + 3T**

Introduction to Biochemistry:

Carbohydrates biological functions: General structure, monosaccharides, disaccharides and polysaccharides

Proteins biological functions: Amino acids, peptide bond, primary, secondary, tertiary and quaternary structure of proteins

Nucleic acids biological functions: Nucleotides, DNA structure and its properties, RNA structure and its properties,

Lipids biological functions: General structure, saturated and unsaturated fatty acids

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the importance of carbohydrates and proteins.
- Identify the structure and properties of nucleic acids and lipids.

UNIT III **9L + 3T**

Introduction to Immunology:

Antigen-Antibody interactions, T-Cells (CD4 and CD8 cells), innate and adaptive immune response, autoimmunity.

Learning Outcomes:

At the end of this unit, student will be able to

- Analyze the antigen and antibody interactions.
- Identify the immune response and autoimmunity.

UNIT IV **9L + 3T**

Enzyme engineering:

Definition of enzyme, classification of enzymes, enzyme-substrate kinetics, immobilization of enzymes, applications of enzymes in various industries and medicine.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply the enzyme substrate kinetics.
- Identify the application of enzymes in various medicines.

UNIT V **9L + 3T**

Viral Dynamics:

Simple growth model, exponential growth and decay, predator-prey model, mathematical modeling of HIV dynamics in a human body.

Learning Outcomes:

At the end of this unit, student will be able to

- Model the growth kinetics.
- Analyze the models of growth kinetics.

Text books:

1. James M. Lee., *Biochemical Engineering*, 1st edition, Prentice-Hall, International Series in the Physical and Chemical Engineering Sciences (**Unit 1, 2 and 4**)
2. Thomas. J. Kindt., Barbara A. O., Richard G., Kuby, *Immunology*, 6th edition, W. H. Freeman & Co (**Unit 3**)
3. Rob J. de Boer & Kirsten ten Tusscher, *Theoretical Biologyand Bioinformatics*, Utrech University (e-material) URL link: http://theory.bio.uu.nl/rdb/books/tb.pdf (**Unit 5**)

Reference book:

1. Pelczar, Jr. Michael, Chan E.C.S., Krieg R.N., *Microbiology*, 6th edition, Tata Mc Graw Hill, Education
2. David L. Nelson., Michael M. Cox, Lehninger, *Principles of Biochemistry*, 6th edition, W. H. Freeman & Co
3. J.D. Murray , *Mathematical Biology I: An Introduction*, 3rd edition, Springer

Open Elective-I

Fuel Cell Technology

Course Code – Category: CHE 311(C) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Engineering Chemistry

Course Objectives:

- To provide with a fundamental understanding of fuel cells and their applications.
- To know the fuel cell components, electrocatalysis, mass transport and fuel cell efficiencies.
- To impart the basic knowledge of the operating principles and reaction kinetics in a fuel cell.
- To characterize a fuel cell and know about the hydrogen storage and safety measures to be taken for proper storage and maintenance.

Course Outcomes:

By the end of the course, student will be able to

1. Demonstrate about a fuel cell and it's applications in automotives.
2. Develop various fuel cells by proper combination of the basic components involved to increase the performance of a fuel cell.
3. Calculate cell efficiencies of different fuel cells and know their performance.
4. Apply the reaction kinetics involved in the operation of a fuel cell for various applications.
5. Design a fuel cell and make provision for hydrogen storage and safety during its storage.

CO – PO – PSO Matrix:

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SYLLABUS

UNIT I **9L + 3T**

Introduction to Fuel Cells: Introduction –types of fuel cells – low, medium and high temperature fuel cell, working of a fuel cell, principles of electrochemical energy conversion, basic electrochemistry, fuel cells for automotive applications – technology advances in fuel cell vehicle systems.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply basic electro chemistry laws.
- Identify the applications of fuel cells.

UNIT II **9L + 3T**

Fuel Cell Components: Electrolytes, catalysts, current collector/bipolar plate, exchange current, electrocatalysis, fuel cell charge and mass transport.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the fuel cell components.
- Identify the components to increase the performance of fuel cell.

UNIT III **9L + 3T**

Fuel Cell Thermodynamics: Gibb's free energy, reversible and irreversible losses, EMF of the hydrogen fuel cell , efficiency and fuel cell voltage , cell efficiency , Gibbs free energy and ideal performance, nernst equation, effect of temperature, pressure, concentration on nernst potential, fuel Crossover, ohmic Losses, charge double layer, fuel cell equations and concept of electrochemical potential.

Learning Outcomes:

At the end of this unit, student will be able to

- Analyze the cause and effects of various parameters on fuel cell.
- Apply the thermodynamic concepts to fuel cell.

UNIT IV **9L + 3T**

Fuel Cell Reaction Kinetics: Introduction to electrode kinetics, activation polarization-concept of electrochemical kinetics, reaction rate, surface coverage, activation polarization for charge transfer reaction, butler-volmer equation, tafel equation, ways to improve kinetic performance, concentration polarization - diffusion transport in electrodes - limiting current density, derivation, transport through flow channels (bipolar plate), ohmic polarization - ionic conductivity, electronic conductivity, current-voltage predictions.

Learning Outcomes:

At the end of this unit, student will be able to

- Analyze the reaction kinetics in fuel cell.
- Identify the ways to improve kinetic performance.

UNIT V **9L + 3T**

Fuel Cell Characterization and Safety: Ways of characterization, in-situ (Electrochemical impedance spectroscopy and cyclic voltammetry) and ex-situ characterization, current interruption technique, hydrogen production and storage, safety issues, cost issues and life cycle analysis of fuel cells.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the safety issues in fuel cells.
- Characterize the fuel cells with respect to safety issues.

Text books:

1. Viswanathan, B and Aulice Scibioh, M., *Fuel Cells: Principles and Applications*., CRC Press, 2008.
2. O 'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, *Fuel Cell Fundamentals*, Wiley, NY 2006.

Reference book:

1. Basu, S.,*Fuel Cell Science and Technology*, Springer, N.Y., 2007.
2. Liu, H., *Principles of fuel cells*, Taylor & Francis, N.Y., 2006.
3. M.T.M. Koper (ed.), *Fuel Cell Catalysis*, Wiley, 2009.

Open Elective-I

Design of experiments

Course Code – Category: CHE 311 (D) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Engineering Chemistry

Course Objectives:

- To Uses of statistics in experimentation.
- To understand role of experimentation in new product design, process development, and process improvement.
- To analyse the result from investigations to obtain conclusions for economic designs
- To become Familiar with methodologies which can be used in conjunction with experimental designs for robustness and optimization

Course Outcomes:

By the end of the course, student will be able to

1. Apply the statistical concepts used in design of experiments.
2. Analyze the experiments and discover the effects.
3. Design and confound the two level experiments.
4. Design and confound the three and mixed level experiments
5. Estimate the parameters using regression models

CO – PO – PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
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SYLLABUS

UNIT I **9L + 3T**

Introduction: Strategy of experimentation, basic principles, guidelines for design of experiments, history of static design.Simple comparative experiments: Basic statistical concepts, sampling and sampling distributions, interferences about the differences in means, randomized designs, paired comparison designs, interference about the variances of normal distributions.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply statistical techniques in experimentation.
- Apply inferences about the differences in means in experimentation.

UNIT II **9L + 3T**

Single factor experiments: Analysis of variance and fixed effect model, model adequacy checking, practical interpretation of results, sample computer output, determining sample size, discovering dispersion effects. Randomized complete block design, Latin square design, Graeco Latin square method

Learning Outcomes:

At the end of this unit, student will be able to

- Analyze the effect of more than one factor.
- Identify the important factor in a given set of factors.

UNIT III **9L + 3T**

2kfactorial design: Introduction, 2^2, 2^3 and 2^k design, single replicate of the 2kdesign, addition of center points to the 2kdesign.Confounding and blocking in factorial designs: Blocking a replicated 2kfactorial design, confounding in the 2kfactorial design, confounding in the 2kfactorial design in two and four and 2pblocks, partial confounding.

Learning Outcomes:

At the end of this unit, student will be able to

- Calculate the factor levels of outcome of an experiment.
- Apply the concepts of factorial design.

UNIT IV **9L + 3T**

Fractional factorial designs two-level: One-half fraction of the 2kdesign, one quarter fraction of the 2kdesign, general 2k-pfractional design. Three-level and mixed-level factorials and fractional factorials: 3kfactorial design, confounding 3kfactorial design, fractional replication of the 3kfactorial design, factorials with mixed levels**.**

Learning Outcomes:

At the end of this unit, student will be able to

- Apply factorial design two-level.
- Apply factorial design three-level.

UNIT V **9L + 3T**

Regression models: Estimation of the parameters in linear regression models, hypothesis testing parameters in multiple regressions, confidence in intervals in multiple regression, prediction of Newton response observations, regression model diagnostics, testing for lack fit. Response surface methodology, parameter optimization Experiments with random factors: Random effect mode, two factorial with random factors, two factor mixed model, sample size determination with random effects, rues for expecyed mean squares, approximate F tests.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply linear regression models to estimate parameters..
- Apply response surface methodology to models.

Text books:

1. D.C. Montgomery, Design and Analysis of Experiments, 7thedition, John Wiley & Sons. Inc., 2013

Reference book:

1. C.F. Jeff Wu & Michael Hamada, Experiments-Panning, Analysis, and Parameter Design Optimization, 2ndedition, John Wiley & Sons. Inc., 2009.
2. R. L. Mason, R. F. Gunst & J.L. Hess, Statistical Design and Analysis of Experiments with Applications to Engineering and Science, 2nd edition, John Wiley & Sons. Inc., 2003.

Open Elective-II

Fundamentals of Industrial Safety and Health

Course Code – Category: CHE 321 (A) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Nil

Course Objectives:

- To understand safety and importance of safety in work place.
- To find the common industrial hazards and their control
- To familiarize the safety laws and legislations

Course Outcomes:

By the end of the course, student will be able to

1. Comprehend concept of safety and safety psychology.
2. Develop a functional knowledge of the various accident prevention methods.
3. Find out electrical and fire hazards and their safety measures
4. Identification and control of work place hazards
5. Summarize safety laws and rules

CO – PO – PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1														
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SYLLABUS

Unit-I: **9L + 3T**

Concept of Safety and Safety Psychology: Definition and Nature of concept of safety, safety terminology, need for safety psychology, general psychological factors, behaviour-based safety.

Learning Outcomes:

At the end of this unit, student will be able to

- Define and summarize concept of safety
- Analyse safety psychology and general psychological factors

Unit-II: **9L + 3T**

Accident Causation and Prevention and Safety Management: Theories and principles of Accident Prevention, The Concept of Management, Safety Management and its Responsibilities, Safety Education and Training and Employee Participation in Safety

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the accident causation and its prevention
- Apply the safety management principles

Unit-III: **9L + 3T**

Common Industrial Hazards: Electrical Hazards and safety procedures, Fire and Explosion and Safety procedures, working at different levels and safety, Tools and safety, use of PPE, First Aid

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the industrial hazards like electrical and fire
- Apply safety procedures for different hazards

Unit-IV: **9L + 3T**

Industrial Hygiene and Health: Hazard identification and risk assessment techniques, Industrial Hygiene, Physiology of Work, Ergonomics, Occupational Health.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify hazards and apply risk assessment techniques
- Anticipation of hazards and their health effects

Unit-V: **9L + 3T**

Safety Laws and Legislation: History of the Safety Movement and the Factories Act, the Act and Rules at a Glance, Laws on Electrical Safety, Laws on Fire & Explosion Safety.

Learning Outcomes:

At the end of this unit, student will be able to

- Comprehend safety acts and rules
- Summarize safety laws

Text Books:

1. Dr. K.U. Mistry, Fundamentals of Industrial Safety and Health, Gajjar Graphics & Printers, 2008
2. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall, 2011

Reference Books:

1. Phil Hughes and Ed Ferrett, Introduction to Health and Safety at Work, 3rd Ed., Butterworth-Heinemann, 2007.
2. Jeremy Stranks, The Health & Safety Handbook, Kogan Page Limited, 2006

Open Elective-II

Bioinformatics

Course Code – Category: CHE 321 (B) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Basic Biology, Basic knowledge in computer programming

Course Objectives:

- Use of computational tools to understand the biological data
- Understand the design of novel drugs using computational tools
- To predict new sequences using the existing sequences in databases
- Student will be able to know the various sources of information

Course Outcomes:

By the end of the course, student will be able to

1. Apply the basics of bioinformatics.
2. Identify the types of databases and retrieve the protein sequence.
3. Apply aligning methods to analyze biological data.
4. Identify different strategy to predict biomolecules
5. Design novel drugs

CO – PO – PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1														
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	3														
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SYLLABUS

UNIT I **9L + 3T**

History, Scope and Importance:

Important contributions - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - internet basics- HTML - introduction to NCBI data model- various file formats for biological sequences

Learning Outcomes:

At the end of this unit, student will be able to

- Tasks of bioinformatics.
- Apply the internet basics to retrieve data.

UNIT II **9L + 3T**

Databases -Tools and Their Uses:

Importance of databases - Biological databases-primary sequence databases- composite sequence databases- secondary databases- nucleic acid sequence databases - protein sequence data bases - structure databases - bibliographic databases - specialized genomic resources- analysis packages

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the biological databases.
- Apply the analysis packages

UNIT III **9L + 3T**

Sequence Alignment Methods:

Sequence analysis of biological data-significance of sequence alignment- pairwise sequence alignment methods- use of scoring matrices and gap penalties in sequence alignments- multiple sequence alignment methods - tools and application of multiple sequence alignment.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply pair wise sequence alignment methods
- Apply multiple sequence alignment methods

UNIT IV **9L + 3T**

Predictive Methods Using DNA and Protein Sequences:

Gene predictions strategies - protein prediction strategies - molecular visualization tools- phylogenetic analysis: concept of trees- phylogenetic trees and multiple alignments..

Learning Outcomes:

At the end of this unit, student will be able to

- Apply the different strategies to predict DNA.
- Apply phylogenetic analysis.

UNIT V **9L + 3T**

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify and optimize the lead compound.
- Apply chemical libraries.

Text books:

1. T K Attwood, D J parry-Smith, *Introduction to Bioinformatics*, Pearson Education, 1st Edition, 11th Reprint 2005.
2. S.C. Rastogi, *Bioinformatics- Concepts, Skills, and Applications*, CBS Publishing, 2003.

Reference Books:

1. David W.Mount, *Bioinformatics sequence and genome analysis*", Cold spring harbor laboratory press, 2004.
2. S. Ignacimuthu, S.J., *Basic Bioinformatics*, Narosa Publishing House, 1995.

Open Elective-II

Corrosion Engineering

Course Code – Category: CHE 321 (C) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Engineering Chemistry

Course Objectives:

- To know about corrosion and its effects
- To have knowledge on types of erosion
- To acquire knowledge on mechanism of corrosion
- To get acquaintance with corrosion testing methods
- To have knowledge on anti-corrosive materials

Course Outcomes:

By the end of the course, student will be able to

1. Analyze the factors for corrosion.
2. Distinguish the various types and corrosion and their effects.
3. Model mathematically the mechanism of corrosion.
4. Determine the rate of corrosion
5. Propose anti-corrosive materials for different industries

CO – PO – PSO Matrix:

		PO												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1														
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SYLLABUS

UNIT I **9L + 3T**

Introduction to corrosion:

Definitions, Factors affecting on the rates of Corrosion. Direct and indirect costs due to corrosion in Industrial practice, Corrosion rates determination from weight loss measurements.

Electrochemical theories of Corrosion, EMF series, Galvanic Series their significance in corrosion monitoring, Corrosion Potential representation by Evans Diagrams, Polarization Over voltage, Activation and Concentration polarization, Nernst Equation and determination of Corrosion potentials. Thermodynamic aspects of Corrosion reactions- Potential-pH phase diagram for Iron Water system

Learning Outcomes:

At the end of this unit, student will be able to

- Apply electrochemical theories of corrosion.
- Determine the corrosion potentials.

UNIT II **9L + 3T**

Types of corrosion:

A Corrosion Cell –its components with examples –types of corrosion cells generally encountered-concentration cells, galvanic or dissimilar metal cells, temperature differentiation cells, Differential aeration cells. Forms of Corrosion-Uniform, Pitting, crevice corrosion, Cavitation erosion, impingement attack, Corrosion fatigue- metallurgical aspects affecting corrosion reactions Area effect, Grain boundary effect.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the types of corrosion.
- Identify the forms of corrosion.

UNIT III **9L + 3T**

Mechanisms of corrosion:

Dezincification, Intergranular Corrosion, mechanism and remedial measures, Stress Corrosion Cracking, Caustic embrittlement, Hydrogen embrittlement mechanism and remedial measures-mechanism of differential aeration corrosion and remedial measures. Biological corrosion due to bacterial habitat, Combination of two dissimilar metal electrodes and relevant current-potential diagrams to evaluate corrosion rates-galvanic Corrosion.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the mechanism of corrosion.
- Evaluate the corrosion rates.

UNIT IV **9L + 3T**

Corrosion testing methods:

Combating Corrosion – Corrosion testing methods: Weight Loss methods, standard expression for corrosion rates-Huey Test, Streicher Test, Warren Test for corrosion. Linear Polarization Technique to evaluate corrosion, interpretation of corrosion data by Nelson's Method. Corrosion Prevention Methods generally followed-Coatings, Organic (paints) and Inorganic coatings-Chemical Conversion coatings- Altering the environment, inhibitors organic and inorganic, altering or modifying the material, alloying essential design rules during fabrication and other precautions during the choice of the material for a given service environment. Passivity, Anodic Protection and Cathodic Protection, Sacrificial anode Method –Current impressed Method-galvanizing of steel.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply the corrosion testing methods.
- Identify the preventive methods for corrosion.

UNIT V **9L + 3T**

Anti-corrosive materials:

Selection for a given Chemical Engineering Service Environment- Materials for Chemical Engineering Industry to resist the given chemical Environment. Ferritic, Austenitic steels and stainless steels-Copper and its alloys-Brasses, bronzes, Nickel and its alloys- Monel alloys-materials for a petroleum refinery industry.

Learning Outcomes:

At the end of this unit, student will be able to

- Identify the anti corrosive material for the given environment.
- Analyze different materials for usage as anti corrosive material.

Text books:

1. Fontana. M.G, and Grene., *Corrosion Engineering*, 3rd edition, 2005, Tata McGraw Hill, New York.

Reference Books:

1. Uhlig. H.H., *Corrosion and Corrosion Control*, 3rd edition, 1985, John Wiley and Sons, New York.

Open Elective-II

Computational tool for Engineers

Course Code – Category: CHE 321 (D) – OE

L	T	P	E	O	Credits: 3
3	0	0	1	2	Sessional Marks: 40
End Exam: 3 Hours					End Exam Marks: 60

Prerequisites: Engineering Mathematics, Basic Knowledge on Computer Programming

Course Objectives:

- To familiarize with MATLAB software to compute ordinary differential equations and integrations

Course Outcomes:

By the end of the course, student will be able to

1. Identify the basic syntax in MATLAB.
2. Solve root finding problems using MATLAB.
3. Apply interpolation techniques in MATLAB.
4. Apply numerical differentiation techniques in MATLAB
5. Apply numerical integration techniques in MATLAB

CO – PO – PSO Matrix:

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SYLLABUS

UNIT I **9L + 3T**

Introduction to MATLAB

Basics of MATLAB, creating, saving and editing a script file, function file and plots, problems on matrix and vectors, matrix and array operations

Learning Outcomes:

At the end of this unit, student will be able to

- create and edit script file in MATLAB.
- Plot in MATLAB.

UNIT II **9L + 3T**

Root finding

Root finding: bisection method, Newton's method, Secant method; least squares approximation.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply bisection method and Newton's method to find the root of a non-linear problem.
- Apply secant method and least square's approximation to find the root of a non-linear problem.

UNIT III **9L + 3T**

Interpolation

Polynomial interpolation, piecewise linear interpolation and cubic spline interpolation.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply polynomial interpolation technique.
- Apply piecewise linear and cubic spline interpolation technique.

UNIT IV **9L + 3T**

Numerical differentiation

Ordinary differential equations: initial value problem: Euler and Runge-Kutta methods; boundary value problem: Finite difference method, shooting method, orthogonal collocation method.

Learning Outcomes:

At the end of this unit, student will be able to

- Apply the initial value problem techniques to solve ODE.
- Apply the boundary value problem techniques to solve ODE.

UNIT V **9L + 3T**

Numerical integration

Numerical integration: mid-point, trapezoidal and Simpson's rule.

Learning Outcomes:

At the end of this unit, student will be able to

- Solve integrations using mid-point method.
- Solve integrations using Trapezoidal and Simpson's rule.

Text books:

1. Rudra Pratap, *Getting started with MATLAB*, 2002, Oxford University Press

Reference Books:

1. S. K. Gupta, *Numerical Methods for Engineers*, New Age Intl. Publishers 2nd ed., 2010
2. Jeffrey R. Chasnov, *Introduction to Numerical Methods,* Lecture notes, The Hong Kong University of Science and Technology.
3. B.S. Grewal, *Higher Engineering Mathematics.*,43rd edition, Khanna Publishers, New Dehli.