**SYLLABI FOR MASTER OF ENGINEERING IN CHEMICAL ENGINEERING EXAMINATIONS 2020-2022**

**SYLLABI FOR MASTER OF ENGINEERING IN CHEMICAL ENGINEERING EXAMINATIONS 2020-2022**

**SCHEME OF TEACHING AND EXAMINATION**

| Paper | Subject | Teaching Hrs. per Week | | | | End Term | Mid Term | Total Marks |
|---|---|---|---|---|---|---|---|---|
| FIRST SEMESTER | | L | T | P | C | | | |
| CHE 1.1 | Mathematical Methods in Chemical Engineering | 4 | - | - | 4 | 50 | 50 | 100 |
| CHE 1.2 | Fluid Mechanics | 4 | - | - | 4 | 50 | 50 | 100 |
| CHE 1.3 | Mass Transfer | 4 | - | - | 4 | 50 | 50 | 100 |
| CHE 1.4 | Chemical Engineering Thermodynamics | 4 | - | - | 4 | 50 | 50 | 100 |
| CHE 1.5 | Transport Phenomena | 4 | - | - | 4 | 50 | 50 | 100 |
| | Total | 20 | - | - | 20 | 250 | 250 | 500 |

L: Lecture hours/Week
P: Practical Hours/Week
C: Number of Credits

Note: Mid Term include: Evaluation towards two minor tests (60% of the marks), Assignments (20% of the marks), Class surprise tests, presentations etc. (20% of the marks).

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**SCHEME OF TEACHING AND EXAMINATION (2020-2022)**

| Paper | Subject | Teaching Hrs. per Week | End Term | Mid Term | Total Marks |
|---|---|---|---|---|---|
| **SECOND SEMESTER** | | | | | |

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**SCHEME OF TEACHING AND EXAMINATION (2020-2022)**

| Paper | Subject | Teaching Hrs. per Week | | | | End Term | Mid Term | Total Marks |
|---|---|---|---|---|---|---|---|---|
| THIRD SEMESTER | | L | T | P | C | | | |
| CHE 3.1 | Open Elective* | 4 | - | - | 4 | 50 | 50 | 100 |
| CHE 3.2 | Elective** | 4 | - | - | 4 | 50 | 50 | 100 |
| CHE 3.3 | Preliminary Thesis# | - | - | 20 | 10 | - | - | - |
| Total | | 8 | - | 20 | 18 | 100 | 100 | 200 |

#: ***Preliminary thesis***

**SYLLABI FOR MASTER OF ENGINEERING IN CHEMICAL ENGINEERING EXAMINATIONS 2020-2022**

## SYLLABUS FOR
## M. E. (CHEMICAL ENGINEERING)
## FIRST SEMESTER

**Paper Title: MATHEMATICAL METHODS IN CHEMICAL ENGINEERING (Theory)**
**Paper Code : CHE 1.1 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

### SECTION-A

***Numerical solutions of simultaneous and higher order differential equations***: Runge-Kutta method, Picard's method. Approximate methods for B.V. problems: Finite difference method.
***Approximate and numerical solutions of PDE's***: Finite difference approximation to derivatives. Numerical solutions of elliptic equations (Laplace and Poisson's equations), Parabolic equations and Hyperbolic equations.
***Integral Functions***: Gamma functions, Beta functions, Elliptic integrals and functions and error functions.

### SECTION-B

Solution methods for linear difference equations, complementary solutions and particular solutions. Nonlinear equations (Riccatic equations).
***Z-Transforms***: Introduction, some standard Z-transforms, linearity property damping rule, some standard results, shifting rules, initial and final value theorems, convolution theorem, evaluation of inverse transforms, applications to difference equations.
***Fourier Transforms***: Introduction, fourier integrals, properties of fourier transforms, convolution theorem, Parseval's identity for F-transform, relation between fourier and laplace transforms, fourier transforms of the derivatives of a function. Applications to boundary value problems.

***Books Recommended*:**

1. Jain, R. K. & Iyengar, S. : Advanced Engg. Mathematics, 2nd

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**Paper Title: MASS TRANSFER(Theory)**
**Paper Code : CHE 1.3 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

## Section A

Fundamentals of Separation Processes; Basic definitions of relevant terms

5. C.J.Geankoplis, Transport Processes and Unit Operations, Prentice-Hall of India Pvt. Ltd., New Delhi (2000).
6. T.K.Sherwood, R.L.Pigford and C.R.Wilke, Mass Transfer, McGraw-Hill, New York (1975).
7. R.E.Treybal, Mass-Transfer Operations, McGraw-Hill, New York (1980).

**Paper Title: CHEMICAL ENGINEERING THERMODYNAMICS(Theory)**
**Paper Code : CHE 1.4 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be d**

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**Instructions for the Paper setter: Total number of questions to be set = 08 with the following distributions:**
**Unit-I : 01 Unit-II : 02 , Unit-III : 02 , Unit-IV: 02 , Unit-V : 01. The students will be required to attempt 5 questions selecting at least 01 question each from Unit-II , Unit-III and Unit-IV, and at least one question from Unit-I and Unit-V**

Section-A

Unit-I

Introduction – Mechanism of molecular transport of momentum. Velocity distributions in laminar flow – shell momentum balances – Flow of falling film – flow of fluids through circular tubes, annulus and between parallel plates. Creeping flow around sphere – Drag calculations.

Unit-II

Equations of change for isothermal systems – Equation of continuity, Equation of Motion, Equations of change in curvilinear coordinates, use of equations of change to set up steady flow problems. Velocity distribution for unsteady laminar flow between two parallel plates.

Unit-III

Unsteady state problems in momentum, energy and Mass Transfer operations. Turbulence – Time smoothing of equations of change of momentum, energy and mass transfer. Eddy properties – Intensity of turbulence Reynolds stresses, Semi empirical expressions for turbulent – momentum – energy and mass fluxes.

Section-B

Unit- IV

Concentration distributions in solids and in laminar flow – shell mass balances, diffusion through a stagnant gas film, Diffusion with homogenous chemical reaction and heterogeneous chemical reaction. Diffusion into a falling liquid film – chemical reaction inside a porous catalyst. Equation of change for a binary mixture – Equation of continuity of a component in curvilinear coordinates.

Unit-V Temperature distributions in solids and in laminar flow- shell energy balances – Heat conduction with electrical, Nuclear, viscous and chemical heat source, Heat conduction through cooling fin, Forced convection and free convection. Unsteady heat conduction for semi-infinite slab. Equations of

change for non-isothermal systems – Equation of energy – use of equations of change to set up steady state flow problems.

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**SYLLABUS FOR M. E. (CHEMICAL ENGINEERING)**
**SECOND SEMESTER**

**Paper Title: HEAT TRANSFER(Theory)**
**Paper Code : CHE 2.1 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

**SECTION-A**

***Analysis of Convection Heat Transfer***: Convection heat transfer, boundary layer fundamentals, conservation of mass, momentum and energy for laminar and flow over a flat plate, dimensionless Boundary – Layer equations & similarity parameters, dimensional analysis, integral equations of the laminar boundary layer, analysis between momentum and heat transfer over a flat surface; turbulent flow and turbulent boundary layers analysis, analysis for turbulent flow over a flat surface.
***Heat Transfer by Natural Convection*:**

***Heat transfer by combined conduction, convection and Radiation***: Thermocouple lead error in surface temperature measurements, heat transfer from radiating fins, the flat plat solar collector, the heat pipe.

***Books Recommended*:**


1. Kays, W. M. & Crawford, M. E. : Convective Heat and Mass Transfer, 3rd Edition, McGraw Hill International Editions, 1993.
2. Frank Kreith & Mark S. Bohn : Principles of Heat Transfer, 6th Edition, Asian Books Private Limited, 2001.
3. Ghoshdastidar, P. S. : Heat Transfer, Oxford University Press, 2004.
4. J P Holman : Heat Transfer, 9th edition, Tata McGraw-Hill, New Delhi. 2008


**Paper Title: RESEARCH METHODOLOGY (Theory)**
**Paper Code : CHE 2.2 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

**SECTION-A**

**Introduction**: Meaning, Features, Objectives/Motives & types of Research; Attributes of good Research, Research Methods and Research Methodology; Research Process, Significance of Research in Managerial decision making.
**Research Design**: Meaning, Characteristics and various concepts relating to research design and classification of research design, Importance.
**Measurement and Scaling**: Data Types Nominal, Ordinal and Ratio scale; scaling techniques.
**Formulation of Hypothesis**: Meaning, Characteristics and concepts relating to testing of Hypothesis (Parameter and statistic, Standard error, Level of significance, type-I and Type-II errors, Critical Region, one tail and two tail) Numerical ------S(r)4(;)-2h Proreure ofo testina

(ANOVA)-One way and Two way ANOVA. Introduction to discriminant analysis and Factor Analysis

**Design of Experiments:**
Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles-replication, randomization, blocking, Guidelines for design of experiments.
Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking.
Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two - factor factorial design; Models-Effects, means and regression, Hypothesis testing

**Report writing**: Style/format, contents and essential steps for report writing.
**Suggested Readings:**
1. K.N. Krishna SwamyAppaLyer Siva KumarM.Mathirajan: Management Research Methodology,Pearson Education, 2009
2. RanjitKumar:Research Methodology, Pearson Education 2009-02-20
3. Donald R. CooperPamela S. Schindler: Business Research Methods, Tata McGraw Hill
4. Michael Riley et.al: Researching & Writing dissertation in Business & Management, ThomsonLearning.
5. R. Pannerselvam: Research Methodology, Parentice Hall of India Limited.
6. R. Nandagopalet.al.:Research Methods in Business, ExcelBooks.
7. William G.Zikmund :Business Research Methods, Thomson South Western Publication
8. C.R. Kothari:Research Methodology-Methods &Techniques.
9. K.V. Rao:ResearchMethodoloty in Commerce &Management.

**Paper Title: CHEMICAL REACTION ENGINEERING(Theory)**
**Paper Code : CHE 2.3 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 ques**

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**Paper Title: PROCESS MODELLING AND SIMULATION(Theory)**
**Paper Code : CHE 2.5 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

## SECTION-A

Introduction to mathematical modeling; Advantages and limitations of models and applications
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**Paper Title: PROCESS MODELLING AND SIMULATION (Practical)**
**Paper Code : CHE 2.6 Max. Marks 25 Credits : 1**

Practicals based on theory covered in Paper CHE 2.5.

**Paper Title: SEMINAR(Practical)**
**Paper Code : CHE 2.7 Max. Marks 25 Credits : 1**

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**M. E. (CHEMICAL ENGINEERING)**
**THIRD SEMESTER**

**Paper Title: OPEN ELECTIVE(Theory)**
**Paper Code : CHE 3.1 Max. Marks 50 Credits : 4 Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

1. **ANALYTICAL TECHNIQUES**

**SECTION-A**

***Complexometric titrations***: Complexes-formation constants; chelates – EDTA, Chelon Effect, EDTA equilibria, effect of pH on EDTA equilibria, EDTA titration curves, endpoint – detection and indicators; Importance of complexometric titrations.

***Solvent Extraction***

| | | | |
|---|---|---|---|
| 2. | Kharbhanda, O.P. | : | Total Project Management, Gower Publishing Co. Ltd., England. |
| 3. | Choudhury | : | Project Management, Tata McGraw Hill, New Delhi,1988. |
| 4. | Rao Ramesh, K.S. | : | Fundamentals of Financial Management, Macmillan Publishing Co., New York, 1989. |
| 5. | Bansal, J.C. and Ghosh, B. | : | Project Management of Process Plants, Panjab University, 1985. |


## 3. OPTIMIZATION TECHNIQUES

### SECTION-A

Introduction to system analysis and Modelling with reference to chemical engineering problems. Differential Method for solving one and two variable problems, with and without constraints, application of Langranian Multiplier method, Linear Programming Modelling, Graphical method, Single Phase Simplex method, Two Phase Simplex method, Duality, Sensitivity analysis.

### SECTION-B

Geometric Programming: as applied to chemical Engineering problems with degree to difficulty equal to zero and one , with and without constraints; Search Methods: Sequential Search method, Golden Section method, Dichotomous Search method; Introduction to Dynamic Programming as applied to discrete multistage problems like Cascade of CSTR, Train of Head exchangers etc.

***Books Recommended*:**


| | | | |
|---|---|---|---|
| 1. | Baveridge and Schecheter | : | Optimisation Theory and Practice, Mc Graw Hill, 1971. |
| 2. | Asghar Hussain | : | Optimisation Techniques for Chemical Engineers, Mc Millan. |
| 3. | Hadley | : | Linear Programming. |
| 4. | Hadley | : | Non-Linear Programming. |


## 4. SAFETY & HAZARDS

### SECTION-A

Definitions, identifications, Classifications and assessment of various types of hazards in work-place environment. Protective and preventive measures in hazard control.

Toxic chemicals: Maximum allowable concentrations and other standards. Biological threshold

Standard safety procedures and disaster control. Indian legislation on safety and prevention of hazards and safety code.
Case study of typical hazardous industry.

***Books Recommended*:**


1. Wells, G.L. : Safety in process Plant Design.
2. Lees, F.P. : Loss Prevention in Process Industries.
3. Chanleft, E.T. : Environmental Protection.
4. Berthowex, P.M. and Rudd, D.E. : Strategy of Pollution control.


## 5. COMPOSITE MATERIALS

### SECTION-A

Concepts underlying formation, characteristics and behavior of plastic-based composites such as fiber glass laminates, structural sandwiches, plywood and load-bearing adhesive joints. Typical components such as metals, glass, synthesis and natural adhesives, plastics, foams, wood, paper, fabrics and rubber.

### SECTION-B

Correlation between adhesion principles and physical behavior,. Methods of design, analysis, fabrication and testing. Discuss failure mechanisms of chemical and mechanical types.

**Paper Title: ELECTIVE(THEORY)**
**Paper Code : CHE 3.2 Max. Marks 50 Credits : 4, Time: 3 hours**
**Course Duration: 45 Lectures of one hour each.**
**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

## 1. INDUSTRIAL POLLUTION CONTROL AND ABATEMENT.

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impact, torsion, electrical properties, optical properties, thermal properties, structure determination-NMR scanning election microscopy, etc.

***Books Recommended*:**


1. Collins, F.A., Bares.J. and Billmeyer, F.W : Experiments in Polymer Science, Wiley-Interscience, 1973.
2. Sorensen, W.R. and Cambell, T.W. : Preparative Methods of Polymer Chemistry, Interscience Publishers, N.Y., 1968.
3. Allan, P.W. : Techniques of Polymer Characterization, Butterworths Scientific Pub., London, 1959.
4. Hennike Jr., J.C. : Infrared Spectrometry of Industrial Polymers." Academic Press, 1967.

## 5. MACROMOLECULAR HYDRODYNAMICS

### SECTION-A

Types of flow, viscosity measurement, flow curve, zero-shear viscosity, activation energy of flow, effect of different parameters on viscosity; Boltzmann principle, Linear Viscoelastic models.

### SECTION-B

Time-temperature superposition principle, WLF equation and its applications, master curve and its use, Flow of Non Newtonian fluids through pipes and channels.
Thermodynamics in Polymer Processing.

***Books Recommended*:**


1. Ferry, J.D. : Viscoelastic Properties of Polymers, Wiley, 1970.
2. Williams, D.J. : Polymer Science & Engineering, Prentice Hall.
3. Mcrum, N.G., Bucknall, C.P. and Bucknall, C.B. : Principles of Polymer Engineering, Oxford University Press, New York, 1988.
4. Williams, H.L. : Polymer Engineering, Elsevier, 1975.