



RAMAIAH
Institute of Technology

CURRICULUM
Outcome Based Education
(Academic Year 2026 – 2027)

CHEMICAL ENGINEERING

VII & VIII Semester B. E.

Batch: 2023

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
(Approved by AICTE, New Delhi & Govt. of Karnataka)
Accredited by NBA & NAAC with A⁺ Grade

About the Institute:

In 1962, Dr. M. S. Ramaiah, a visionary philanthropist, established the Gokula Education Foundation with a noble mission to uplift society through education. The same year marked a pivotal moment in technical education in India with the founding of the M S Ramaiah Institute of Technology (MSRIT).

MSRIT offers an impressive array of 18 undergraduate and 15 postgraduate programs, all approved by the All India Council for Technical Education (AICTE). The National Board of Accreditation (NBA) has accredited all eligible programs at the undergraduate (UG) and postgraduate (PG) levels. In March 2021, MSRIT earned an 'A+' grade from the National Assessment and Accreditation Council (NAAC), underscoring its unwavering commitment to academic excellence. Since 2007, the institute has proudly held Autonomous Status for its UG and PG programs, a prestigious recognition granted by the University Grants Commission (UGC) and Visvesvaraya Technological University (VTU). According to the Ministry of Education, Government of India's NIRF Ranking Framework, MSRIT ranks 75th among 1,584 leading engineering institutions and 31st among 131 architecture schools in India for 2025, highlighting its remarkable impact and leadership in education.

The institute participated in the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. To foster a research culture, the institute has established several specialized centres, including the Centre for Imaging Technologies, the Centre for Advanced Materials Technology, the Centre for Antennas and Radio Frequency Systems (CARFS), the Centre for Cyber Physical Systems, the Schneider Centre of Excellence, the Centre for Bio and Energy Materials Innovation, JSW Centre of Excellence in Power Systems and more. MSRIT boasts a faculty of 380 highly qualified members, 70% of whom hold doctoral degrees, and over 300 scholars currently pursuing Ph.D. degrees.

The Entrepreneurship Development Cell (EDC) and "Ramaiah Evolute" have been established on campus to support startup incubation. MSRIT features a dedicated Placement and Training department, a strong mentoring and proctorial system, a fully equipped sports department, and a spacious, air-conditioned library with a wide range of books and subscriptions to both international and national journals. The Digital Library provides access to online e-journals from renowned publishers, including Elsevier ScienceDirect, IEEE, Taylor & Francis, and SpringerLink. Additionally, the Institute is a member of DELNET, CMTI, and the VTU E-Library Consortium.

The institute features a state-of-the-art auditorium, a well-equipped recording studio, and multiple advanced conference halls with videoconferencing capabilities. Additionally, MSRIT provides excellent hostel accommodations for both boys and girls, ensuring a comfortable living environment. MSRIT alumni have achieved remarkable success, holding prominent positions in India and internationally. They maintain strong connections with the institute through an engaged and active Alumni Association.

Founded on Dr. Ramaiah's unwavering commitment to knowledge and innovation, this remarkable institution continues to inspire generations of students and shape the future of engineering and technology in the country.

About the Department

Established in 1978, the Department of Chemical Engineering at MSRIT was the fifth department launched by the institute. It began with an intake of 40 students, later increased to 60 in 2002. The department has steadily advanced toward achieving its mission and is now recognized as a significant contributor to Chemical Engineering education in India. Accredited Four times in succession by the National Board of Accreditation, the department has also earned an 'A+' grade from NAAC. More than 2500 students have graduated across 44 batches. The department offers robust infrastructure, and its students have received various prestigious awards, participated in international internships, and earned high accolades for their innovative projects. Faculty members possess diverse expertise and are actively engaged in advanced technological research.

The department is a VTU-approved Research Centre, offering M.S (by Research) and Ph.D. programs. The alumni of the department have held prominent positions in industry and academia around the world. Many alumni are entrepreneurs, contributing actively to nation-building. Under the aegis of the IIChE Student Chapter, the department organizes enriching industry interactions and encourages student development. A range of research projects, sponsored by DRDO, VTU, IEI, and KSCST have been successfully led by the department. The department also hosts the Bangalore Regional Centre of the Indian Institute of Chemical Engineers, which has been operating for nearly two decades from the department. In 2011, MSRIT proudly organized CHEMCON-2011, the flagship event of the Indian Chemical Engineering Congress, drawing top chemical engineering professionals across the globe.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

RIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M S Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To be a leading chemical engineering department for imparting quality technical education and progressive research at global level.

MISSION OF THE DEPARTMENT

1. To provide a state of art environment and a rigorous academic program that train students to excel in fundamental sciences, chemical and allied engineering fields.
2. To offer a programme that inculcates creative thinking and lifelong learning contributing to the advancements in chemical sciences and its application.
3. To foster principles of sustainability and promote environmentally benign technologies for the benefit of society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: To produce graduates with a strong foundation and understanding of the fundamental principles of mathematics, science and engineering enabling graduates to pursue their careers as practicing chemical engineers in Chemical and Allied Engineering fields.

PEO2: To produce graduates who are prepared to pursue their post-graduation and Research in the emerging and allied areas of Chemical Engineering and Business.

PEO3: To produce graduates who possess skills with professional integrity and ethics to assume professional leadership roles and administrative positions.

PEO4: To provide students with opportunities to integrate with multidisciplinary teams to develop and practice written and oral communication skills.

PROGRAM OUTCOMES (POs):

On completion of 4 year B.E. Degree program, Chemical Engineering graduates will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

PROGRAM SPECIFIC OUTCOMES (PSOs):

The Chemical Engineering graduate will be able to

PSO1: Acquire in-depth knowledge of chemical engineering, process economics, management, safety and environmental aspects required to pursue their career in chemical industry and allied engineering areas.

PSO2: Apply computational and simulation tools to solve, design and optimize chemical engineering problems/ processes.

PSO3: Design processes, perform experiments, prepare technical and management modules, economic evaluation and demonstrate professional engineering competence

Semester wise Credit Breakdown for B.E Degree Curriculum Batch 2023-27

Semester	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Course Category									
Basic Science Course (BSC)	08	08	03	03	---	---	---	---	22
Engineering Science Courses(ESC/ PLC/ETC)	08	09	---	---	---	---	---	---	17
Humanities, Social Sciences and Management (HSMC)	02	02	---	---	03	03	---	---	10
Ability Enhancement Course (AEC)	02	01	01	01	01	---	---	---	06
Skill Development Course (SDC)	---	---	---	---	---	01	02	---	03
Universal Human Values (UHV)	---	---	02	---	---	---	---	---	02
Professional Courses Core (PCC)	---	---	11	12	12	06	04	---	45
Integrated Professional Core Course (IPCC)	---	---	04	04	03	---	04	---	15
Professional Electives Courses - (PEC)	---	---	---	---	03	06	03	---	12
Open Elective Courses (OEC)	---	---	---	---	---	03	03	---	06
Internship (INT)	---	---	---	---	---	---	---	05	05
Mini Project/ Project Work(PW)	---	---	---	---	---	04	---	13	17

Non Credit Mandatory Courses (NCMC)	---	---	---	Yes	Yes	Yes	---	---	---
Total Credits	20	20	21	20	22	23	16	18	160

SCHEME OF TEACHING VII SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week			
					L	T	P	Total	L	T	P	S
1	CH71	Plant Design & Economics	Chemical Engineering	IPCC	3	0	1	4	3	0	2	3
2	CH72	Transport Phenomena	Chemical Engineering	PCC	2	1	0	3	2	2	0	2
3	CHE73X	Program Elective Course – 4	Chemical Engineering	PEC	3	0	0	3	3	0	0	3
4	CHOE02*	Institutional Open Elective – 2	Chemical Engineering	IOE	3	0	0	3	3	0	0	3
5	CHL74	Simulation Lab-II	Chemical Engineering	PCC	0	0	1	1	0	0	2	0
6	CHL75	Skill Enhancement Lab	Chemical Engineering	AEC	0	1	1	2	0	2	2	0
Total					11	2	3	16	11	4	6	11

Program Elective Course- 4

CHE731	Drug Delivery Systems	CHE734	Process Integration
CHE732	Natural Gas Engineering & Transportation	CHE735	Solid Waste Management
CHE733	Separation Techniques		

Institutional Open Elective- 2

CHOE02*	Green Technology
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Note: Minimum of 1 subject should have a Tutorial component of 1 Credit.

Nomenclature: **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **AEC**–Ability Enhancement Courses, **SDC** : Skill Development Course

L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: CHE73x, where x=1,2,3,4,5

CHOE0x*, where x=6,... continued from previous

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Proctor.

Selection of an open elective shall not be allowed if,

The candidate has studied the same course during the previous semesters of the program.

The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

A similar course, under any category, is prescribed in the higher semesters of the program.

The minimum students' strength for offering open electives is 10.

AICTE Activity Points to be earned by students admitted to BE program:

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fail to earn the prescribed activity points; VIII semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII Semester grade card.

SCHEME OF TEACHING VIII SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week			
					L	T	P	Total	L	T	P	S
1	CHP81	Project Work	Chemical Engineering	PW	0	0	13	13	0	0		
2	INT82	Research/Industrial Internship	Chemical Engineering	INT	0	0	5	5	0	0		
Total					0	0	18	18				

Nomenclature: PW: Project Work, NCMC: Non-credit Mandatory Course, INT –Internship

L –Lecture, T – Tutorial, P- Practical/ Drawing

SEMESTER VII

PLANT DESIGN AND ECONOMICS

Course Code: CH71	Credits: 3:0:1
Pre – requisites: Nil	Contact Hours: 45L+30P+45S
Course Coordinator: Dr. Sravanthi V	

Course Content

Unit I

Introduction: Introduction, Typical Design Steps, Flow Diagram - Mass and Energy Balance, Piping and Instrumentation Diagram, selection of Process Equipment, Process Utilities, Plant Location and Plant layout.

- Pedagogy / Course delivery tools: Chalk and talk
- Link: <https://nptel.ac.in/courses/103105166>
- Laboratory session: Material and Energy Balance

Unit II

Cost Analysis: Factors involved in project cost estimation, methods employed for the estimation of the capital investment. Estimation of working capital. Time value of money and equivalence.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103105166>
- Laboratory session: Estimation of Capital Investment

Unit III

Depreciation and Taxes: Depreciation calculation methods. Equivalence after Taxes. Cost comparison after taxes.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103105166>
- Laboratory session: Depreciation Calculations

Unit IV

Profitability: Methods for the evaluation of profitability. Break-even analysis.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103105166>
- Laboratory session: Profitability Evaluation and Breakeven Analysis

Unit V

Design report: Introduction to design of reports. Types of reports, Organization of report and purpose of report. Case Study

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103105166>
- Laboratory session: Techno Economical Analysis using ASPEN Plus

Text Books:

1. Plant design and Economics for Chemical Engineers-Peters & Timmerhaus, 4th edn, McGrawHill 1991.

Reference Books:

1. T.R. Banga & S.C. Sharma Industrial Organization & Engineering Economics 22nd edn. Khanna Publishers 1999.

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Explain the various aspects of Plant Design and plant layout. (PO-1,2, 4, 5, 8, 10, 11, PSO-1,2,3)
2. Perform cost analysis and estimate working capital for process industries. (PO-1,2, 4, 5, 8, 10, 11, PSO-1,2,3)
3. Calculate and analyse the costs of depreciation and taxes. (PO-1,2, 4, 5, 8, 10, 11, PSO-1,2,3)
4. Apply alternative methods to estimate profitability. (PO-1,2, 4, 5, 8, 10, 11, PSO-1,2,3)
5. Develop detailed project report for industry. . (PO-1,2, 4, 5, 8, 10, 11, PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Lab experimental work & Record writing	15	CO1, CO2, CO3, CO4, CO5
Lab Test	05	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

TRANSPORT PHENOMENA	
Course Code: CH72	Credits: 2:1:0
Pre – requisites: Momentum Transfer, Process Heat Transfer, Mass transfer	Contact Hours: 30L+30P+30S
Course Coordinator: Dr. Rajeswari M Kulkarni	

Course Content

Unit I

Introduction: Fundamental laws of Transport phenomena – Newton’s law of viscosity, Fourier’s law of heat conduction and Fick’s law of diffusion. Molecular theory of viscosity, thermal conductivity and diffusivity of gases at low density. Theory of viscosity of liquid.

Molecular mechanisms for transport of momentum in liquids. Analogy between the laws. Types of fluids; Types of flow. Numerical problems on the application and use of NLV, FLHC and FLD.

- Pedagogy / Course delivery tools: Chalk and talk
- NPTEL Links: Transport Phenomena, Prof. Sunando Dasgupta

Unit II

Shell Balances for Momentum transfer: Steady state Shell momentum balances, Pressure driven fully developed laminar flow in a pipe and annulus, Gravity driven flow in a thin film on an inclined plane, Flow between parallel plates. Analytically solvable problems.

Non Newtonian flow in a tube and over flat plate (Power law and Bingham fluids).

- Pedagogy / Course delivery tools: Chalk and talk
- NPTEL Links: Transport Phenomena, Prof. Sunando Dasgupta

Unit III

Shell balances for energy transfer: Steady State Shell Energy Balances, Temperature profile in a single and composite slab. Steady state one dimensional heat conduction with temperature dependent thermal conductivity. Heat conduction with internal generation by electrical, nuclear, viscous energy sources. Analytically solvable problems.

- Pedagogy / Course delivery tools: Chalk and talk
- NPTEL Links: Transport Phenomena, Prof. Sunando Dasgupta

Unit IV

Concentration Distributions in Laminar Flow: Steady state Shell mass balances. Diffusion through stagnant gas and liquid films (isothermal and non-isothermal films). Equimolar counter diffusion. Diffusion with homogeneous and heterogeneous reaction. Diffusion and chemical reaction inside a porous catalyst.

- Pedagogy / Course delivery tools: Chalk and talk
- NPTEL Links: Transport Phenomena, Prof. Sunando Dasgupta

Unit V

Equations of Change: Equation of continuity. Equation of motion; Navier – Stokes equation. Application of these equations in solving simple steady state momentum transfer problems previously discussed.

Analogies: Analogies between Momentum, Heat and Mass Transport: Reynold's, Prandtl's and Chilton & Colburn analogies.

- Pedagogy / Course delivery tools: Chalk and talk
- NPTEL Links: Transport Phenomena, Prof. Sunando Dasgupta

Text Book:

1. Bird, Stewart and Lightfoot, Transport Phenomena, I & II Edition, John Wiley, 1994 & 2002.

Reference Books:

1. Welty, Wicks and Wilson, Fundamentals of Momentum, Heat and Mass Transport, 3rd Edition, John Wiley, 1983.

Course Outcomes (COs):

On successful completion of the course students will be able to

1. Elucidate different fundamental laws of transport and analyze the behavior of transport properties with changes in operating conditions. (PO-1, 2, 3, PSO-1)
2. Derive mathematical equations by shell balance technique for different practical flow problems. (PO-1, 2, 3, PSO-1)
3. Derive mathematical equations by shell balance technique for different practical heat transfer problems. (PO-1, 2, 3, PSO-1)
4. Derive mathematical equations by shell balance technique for different practical mass transfer problems. (PO-1, 2, 3, PSO-1)
5. Apply transport equations to any kind of physical problem and develop mathematical equations representing the process. (PO-1, 2, 3, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignments/Problem solving	20	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

DRUG DELIVERY SYSTEMS	
Course Code: CHE731	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 45L+45S
Course Coordinator: Dr. Alex Koshy	

Course content

Unit I

Controlled Drug Delivery Systems: Introduction, terminology/definitions and rationale, advantages and limitations. pharmacokinetics and pharmacodynamics, selection of drug candidates based on physicochemical properties (solubility, diffusivity, stability, partition coefficient). Mechanistic design of controlled release systems based on diffusion, dissolution and ion exchange principles. Mathematical description of drug release kinetics (zero-order, first-order, Higuchi, Korsmeyer–Peppas models).

- Pedagogy/Course delivery tools: Chalk and talk and PowerPoint presentation
- Link: https://onlinecourses.nptel.ac.in/noc19_bt23/preview

Unit II

Polymers for controlled release: Introduction, classification (natural, synthetic, biodegradable, stimuli-responsive), properties (molecular weight, crystallinity, glass transition, permeability), degradation kinetics, advantages and application of polymers in formulation of controlled release drug delivery systems.

Microencapsulation: Definition, advantages and limitations, Microparticles, microspheres and microcapsules, methods of microencapsulation, applications.

- Pedagogy/Course delivery tools: Chalk and talk and PowerPoint presentation
- Link: https://onlinecourses.nptel.ac.in/noc19_bt23/preview

Unit III

Mucosal Drug Delivery System: Introduction and concept, Principles of bio-adhesion/muco-adhesion, transmucosal permeability, formulation considerations of buccal delivery systems.

Naso Pulmonary Drug Delivery Systems: Introduction to Nasal and Pulmonary routes of drug delivery, Principle of inhalers (dry powder and metered dose), nasal sprays, nebulizers.

Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches.

- Pedagogy/Course delivery tools: Chalk and talk and PowerPoint presentation
- Link: https://onlinecourses.nptel.ac.in/noc19_bt23/preview

Unit IV

Gastro Retentive Drug Delivery Systems: Introduction, approaches towards gastroretention – Floating DDS, high-density systems, inflatable and gastro adhesive systems and their applications.

Implantable Drug Delivery Systems: Introduction, Concept of osmosis and osmotic pressure, Principle and types of implants and osmotic pump.

Intrauterine and Contraceptive Drug Delivery Systems: Introduction, hormonal and non-hormonal IUDs and their applications, novel approaches to male contraception.

- Pedagogy/Course delivery tools: Chalk and talk and PowerPoint presentation
- Link: https://onlinecourses.nptel.ac.in/noc19_bt23/preview

Unit V

Targeted Drug Delivery: Concept and approaches, introduction to liposomes, niosomes, nanoparticles and monoclonal antibodies.

Ocular Drug Delivery Systems: Introduction, intra-ocular barriers and methods to overcome, ocular formulations and ocuserts.

- Pedagogy/Course delivery tools: Chalk and talk and PowerPoint presentation
- Link: https://onlinecourses.nptel.ac.in/noc19_bt23/preview

Text Books:

1. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
2. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Reference Books:

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.

3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim.

Course Outcomes (COs):

On completion of this course student will have improved ability to:-

1. Explain the fundamental concepts and design principles involved in controlled drug delivery systems. (PO2, PO3, PO10, PSO1)
2. Identify the fundamental concepts of microencapsulation and discuss the material considerations of CDDS (PO-2, 3, 6; PSO-1).
3. Recall the principles of mucosal, naso-pulmonary and transdermal drug delivery and apply the acquired knowledge in the selection of suitable drug delivery strategies. (PO2, PO3, PSO1)
4. Summarize the mechanisms of gastro-retentive, implantable and intrauterine drug delivery systems to design site-specific formulation approaches. (PO2, PO3, PSO1)
5. Explain targeted and ocular drug delivery mechanisms and analyze their therapeutic applications. (PO2, PO3, PSO1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1 & CO2
Internal Test-II	30	CO3, CO4 & CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignment/Research paper	10	CO1, CO2, CO3, CO4 & CO5
Assignment/Quiz	10	CO1, CO2, CO3, CO4 & CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4 & CO5

NATURAL GAS ENGINEERING AND TRANSPORTATION	
Course Code: CHE732	Credits: 3:0:0
Pre – requisites: Petroleum Technology, Chemical Engineering Thermodynamics,	Contact Hours: 45L+45S
Course Coordinator: Chemical Engineering Faculty	

Course Content

Unit I

Introduction: Overview of the gas industry and gas processing, Field operations and inlet receiving.

Gas Compression: Methods of gas compression, thermodynamic considerations.

- Pedagogy / Course delivery tools: Chalk and talk
- Link: <https://nptel.ac.in/courses/103103140>

Unit II

Natural Gas Processing: Fundamentals of vapour-liquid equilibrium and distillation, Gas hydrates, Gas dehydration.

- Pedagogy / Course delivery tools: Chalk and talk
- Link: <https://nptel.ac.in/courses/103103140>

Unit III

Natural Gas Purification: Cryogenic extraction of natural gas liquids (NGL). Minor component (nitrogen, helium, mercury, and BTEX) recovery or removal. Acid Gas (hydrogen sulfide and carbon dioxide) removal.

- Pedagogy / Course delivery tools: Chalk and talk
- Link: <https://nptel.ac.in/courses/115105106>

Unit IV

Condensate and NGL Sweetening: Sweetening and dehydration of condensate and natural gas liquids (NGL). Sulfur recovers with the Claus process, Tail gas clean-up.

- Pedagogy / Course delivery tools: Chalk and talk
- Link: <https://nptel.ac.in/courses/115105106>

Unit V

Acid Gas Management and LNG: Acid gas injection. Liquefied natural gas (LNG), production, storage, transportation, and regasification.

- Pedagogy / Course delivery tools: Chalk and talk
- Link: <https://nptel.ac.in/courses/103103140>

Text Books:

1. Katz, D. L. and Lee, R.L., Natural Gas Engineering, McGraw Hill, 1990.

Reference Books:

1. Kidnay, A.J., Parnish, W.R., Dekker, Fundamentals of Natural Gas Processing, McGraw Hill.
2. Mokhtab, S., Handbook of Natural Gas Transmission and Processing.

Course Outcomes (COs):

On successful completion of the course students will be able to

1. Elucidate the principles of gas compression in natural gas industry. (PO-1, 2, 3, 7, PSO-1)
2. Understand various methods of gas dehydration. (PO-1, 2, 3, 7, PSO-1)
3. Explain gas treatment processes and impurity removal methods. (PO-1, 2, 3, 7, PSO-1)
4. Comprehend the gas processing techniques. (PO-1, 2, 3, 7, PSO-1)
5. Understand LNG production and transportation system. (PO-1, 2, 3, 7, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignments	10	CO1, CO2, CO3, CO4, CO5
Quiz/Research Paper/Presentation	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

SEPARATION TECHNIQUES	
Course Code: CHE733	Credits: 3:0:0
Pre – requisites: Mass Transfer I & II	Contact Hours: 45L+45S
Course Coordinator: Dr. D Jayaprasanna Kumar	

Course Content

Unit I

Adsorptive separations: Review of fundamentals. Mathematical modelling of column factors. Pressure swing & thermal swing adsorption. Counter current separations.

- Pedagogy / Course delivery tools: Chalk and talk
- <https://nptel.ac.in/courses/103105061>

Unit II

Chromatography: Chromatography fundamentals. Different types. Gradient & affinity chromatography. Design Calculations for chromatographic columns.

- Pedagogy / Course delivery tools: Chalk and talk
- <https://nptel.ac.in/courses/103105061>

Unit III

Membrane separation processes: Thermodynamic considerations. Mass transfer considerations. Design of RO & UF. Ion selective membranes. Micro filtration. Dialysis, Electro dialysis. Pervaporation. Gaseous separations.

- Pedagogy / Course delivery tools: Chalk and talk
- <https://nptel.ac.in/courses/103105061>

Unit IV

Surfactant based separations: Fundamentals. Surfactants at inter phases and in bulk. Liquid membrane permeation. Foam separations. Micellar separations.

Super critical fluid extraction: Thermodynamics and physico chemical principles. Process description. Application. Case Study.

- Pedagogy / Course delivery tools: Chalk and talk
- <https://nptel.ac.in/courses/103105061>

Unit V

External field induced separations: Electric & magnetic field separations. Centrifugal separations and calculations.

Other Separations: Separation by thermal diffusion, electrophoresis and crystallization.

- Pedagogy / Course delivery tools: Chalk and talk
- <https://nptel.ac.in/courses/103105061>

Text Books:

1. Rousseu, R.W., Handbook of Separation Process Technology, John Wiley & Sons.
2. Seader JD, Henley EJ, Roper, Separation process principles, John Wiley & Sons, 3rd edition.

Reference Books:

1. Kirk-Othmer, Encyclopaedia of Chemical Technology, 5th Edition, 2007.
2. Wankat, P.C., Rate Controlled Separations, Springer, 2005.
3. Wankat, P. C., Large Scale Adsorption Chromatography, CRC Press, 1986.

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Elucidate different types of adsorptive separations and design the adsorption column. (PO-1,2, PSO-1)
2. Analyze the separation system for multi-component mixtures and design the chromatographic columns. (PO-1,2, PSO-1)
3. Analyze the rate of permeate flux of membranes for separation processes reverse osmosis, dialysis, ultra-filtration, and electro dialysis. (PO-1,2, PSO-1)
4. Comprehend concepts of surfactant based separations, physico-chemical aspects and applications of super critical fluid extraction. (PO-1,2, PSO-1)
5. Analyze the applicability of electric, magnetic and centrifugal separation processes. (PO-1,2, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignments	10	CO1, CO2, CO3, CO4, CO5
Quiz/Research Paper/Presentation	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

PROCESS INTEGRATION	
Course Code: CHE734	Credits: 3:0:0
Pre – requisites: Process Heat Transfer Mass Transfer I & II	Contact Hours: 45L+45S
Course Coordinator: Dr. G.M. Madhu	

Course Content

Unit I

Introduction to Process Integration and Overall Mass Targeting: Introduction to Process Integration, Generating Alternatives for Debottlenecking and Water Reduction, Process Synthesis, Process Analysis, Targeting for Minimum Discharge of Waste, Targeting for Minimum Purchase of Fresh Material Utilities, Mass-Integration Strategies for Attaining Targets.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103107094>

Unit II

Graphical Techniques for Direct Recycle and Mass Exchange Network: Source–Sink Mapping Diagram and Lever-Arm Rules, Direct-Recycle Targets Through Material Recycle Pinch Diagram, Design Rules from the Material Recycle Pinch Diagram, Design of Individual Mass Exchangers, Cost Optimization of Mass Exchangers, Synthesis of Mass Exchange Networks, Mass Exchange Pinch Diagram, Constructing the Pinch Diagram without Process MSAs,

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103107094>

Unit III

Algebraic Approach for Direct Recycle and Targeting of Mass Exchange: Algebraic Targeting Approach, Algebraic Targeting Procedure, Case Study: Composition-Interval Diagram, Table of Exchangeable Loads, Mass Exchange Cascade Diagram,

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103107094>

Unit IV

Heat Integration: Graphical and Algebraic Approach: Synthesis of Heat Exchange

Networks (HENs), Heat Exchange Pinch Diagram, Minimum Utility Targeting Through an Algebraic Procedure, Screening of Multiple Utilities Using the Grand Composite Representation.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103107094>

Unit V

Combined Heat and Power Integration and Overview of Optimization: Heat Engines, Heat Pumps, and Thermal Pinch Diagram, Mathematical Programming, Classification of Optimization Programs, Formulation of Optimization Models, Lingo Software, Interaction between Direct Recycle and the Process.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/103107094>

Text Books:

1. Mahmoud. M., El – Hawalgi, Process Integration, Elsevier, 2006.
2. Robin Smith, Chemical Process Design & Integration, Wiley, 2005.

Reference Book:

1. Kemp I.C, Pinch Analysis and Process Integration - A user guide on process integration for efficient use of energy, 2nd Edition, Butterworth – Heinemann, 2006.

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Explain the need for Mass and Heat integration in chemical industries and basic principles involved in process integration. (PO-1,4,6,7,8, PSO-1)
2. Calculate the minimum amount of heat required in heat integration. (PO-1, 2, 4,6,7,8, PSO-1, 2)
3. Calculate the minimum fresh solvent required in mass exchange networks by graphical and algebraic methods. (PO-1,2,3,4,6,7,8, PSO-1,2)
4. Calculate the minimum heating and cooling requirements for given process using pinch analysis by graphical and algebraic methods. (PO-1,2,3,4,6,7,8, PSO-1,2)
5. Able to find the quality heating requirements in process flow diagram and able to optimize mass and heat integration problems by Linear programming method. (PO-1,2,3,4, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignments	10	CO1, CO2, CO3, CO4, CO5
Assignments /Quiz	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

SOLID WASTE MANAGEMENT	
Course Code: CHE735	Credits: 3:0:0
Pre – requisites: Environmental Engineering	Contact Hours: 45L+45S
Course Coordinator: Dr. J Koteswararao	

Course Content

Unit I

Introduction: Definition, characteristics and perspectives of solid waste. Types of solid waste. Physical and chemical characteristics. Variation of composition and characteristics. Municipal, industrial, special and hazardous wastes.

General aspects: Overview of material flow in society. Reduction in raw material usage. Reduction in solid waste generation. Reuse and material recovery. General effects on health and environment. Legislations.

- Pedagogy: Chalk and talk, power point presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_ce66/preview
- <https://www.youtube.com/watch?v=BJKmlkK1JD8>
- <https://www.youtube.com/watch?v=Mm3p96vcM0Q>

Unit II

Engineered systems: Typical generation rates. Estimation and factors effecting generation rates. On site handling. Storage and processing. Collection systems and devices. Transfer and transport.

- Pedagogy: Chalk and talk, power point presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_ce66/preview

Unit III

Processing Techniques: Mechanical volume reduction. Thermal volume reduction. Component separation. Land filling and land forming. Deep well injection.

- Pedagogy: Chalk and talk, power point presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_ce66/preview

Unit IV

Material recovery: Mechanical size alteration. Electromagnetic separation. Drying and dewatering. Other material recovery systems. Recovery of biological conversion products. Recovery of thermal conversion products.

Energy recovery: Energy recovery systems and efficiency factors. Determination of output and efficiency. Details of energy recovery systems. Combustion incineration and heat recovery. Gasification and pyrolysis. Refuse derived fuels (RDF).

- Pedagogy: Chalk and talk, power point presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_ce66/preview

Unit V

Case studies: Major industries and management methods used in typical industries – Coal fired power stations, textile industry, oil refinery, distillery, sugar industry, and radioactive waste generation units.

- Pedagogy: Chalk and talk, power point presentations
- <https://www.youtube.com/watch?v=HBkwTyBI75M>

Text Books:

1. Howard S. Peavy, Environmental Engineering, McGraw Hill International Edition, 1986.
2. Dutta, Industrial Solid Water Management and Land Filling Practice, Narose Publishing House, 1999.

Reference Books:

1. Sastry C.A., Waste Treatment Plants, Narose Publishing House, 1995.
2. Lagrega, Hazardous Waste Management, McGraw Hill, 1994.

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Apply knowledge to characterize the solid waste. (PO-1, 2, 3, 4, 6, 7, 8, PSO-1,2,3)
2. Understand the various functional element in solid waste management and perform calculations. (PO-1, 2, 3, 4, 6, 7, 8, PSO-1,2,3)
3. Apply various processing techniques and suitable design considerations for land filling sites. (PO-1, 2, 3, 4, 6, 7, 8, PSO-1,2,3)
4. Apply techniques of material recovery and energy recovery from solid waste. (PO-1, 2, 3, 4, 6, 7, 8, PSO-1,2,3)
5. Develop a management plan for handling solid waste for various process industries and municipalities (PO-1, 2, 3, 4, 6, 7, 8, PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignment/Report	10	CO1, CO2, CO3
Case Study/Quiz	10	CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

INSTITUTIONAL OPEN ELECTIVE-II

GREEN TECHNOLOGY	
Course Code: CHOE02	Credits: 3:0:0
Pre – requisites: Engineering Chemistry	Contact Hours: 45L+45S
Course Coordinator: Dr. Ramasivakiran Reddy	

Course Content

Unit I

Introduction: Green chemistry and technology for sustainable development, Environmental laws, Functions of CPCB and SPCB, carbon credits, environmental management system standards - ISO 14000 series.

- Pedagogy / Course delivery tools: Chalk and talk
-

Unit II

Green Chemistry: Principles of Green Chemistry, Atom efficiency, Energy conservation, Waste minimization techniques, Substitution principle.

- Pedagogy / Course delivery tools: Chalk and talk
-

Unit III

Life-Cycle Assessment: History, Process, life cycle stages, LCA Methodology, Streamlining LCA and Applications of LCA

- Pedagogy / Course delivery tools: Chalk and talk

Unit IV

Pollution Prevention Planning: Structure of the pollution prevention process, Environmental Audits, toxic release inventory.

- Pedagogy / Course delivery tools: Chalk and talk

Unit V

Design for the Environment: Design for X, improvement in manufacturing operations, design for disassembly / de manufacturing, packaging, case studies.

- Pedagogy / Course delivery tools: Chalk and talk

Text Books:

1. Paul L. Bishop, Pollution Prevention: Fundamentals and Practice, McGraw Hill, 2000.
2. Anastas P.T., Warner J.C., Green Chemistry: Theory and Practice. Oxford Science Publications, Oxford, 1998.

Reference Books:

1. Mike Lancaster, Green Chemistry- An Introductory Text, Royal Society of Chemistry Publishing, 2010
2. Boyle, Godfrey, Bob Everett, Janet Ramage, Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2004.

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Explain environment laws, carbon credits, ISO 14000 series. (PO-1, 4, 6, 7, PSO-1)
2. Understand the principles of green chemistry. (PO-3, 4, 6,7, PSO-1)
3. Explain the importance of green technology in sustainable development. (PO-3, 4, 6,7, PSO-1)
4. Apply tools of green technology and life cycle assessment. (PO-3, 4, 6, 7, PSO-1)
5. Conduct pollution prevention planning and environment friendly design. (PO-3, 4, 6,7, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignment/Report	10	CO1, CO2, CO3
Case Study/Quiz	10	CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

SIMULATION LABORATORY - II	
Course Code: CHL74	Credits: 0:0:1
Pre – requisites: Nil	Contact Hours: 30P
Course Coordinator: Dr. Ramasivakiran Reddy	

Course Content

List of simulations suggested:

1. Develop and simulate a process flowsheet and optimize the selected operating parameters for improved process performance.
2. Perform sensitivity analysis and evaluate the effect of key operating parameters on process performance.
3. Simulate an azeotropic distillation process and evaluate the effect of operating conditions on separation efficiency.
4. Develop and simulate a reactive distillation process and analyze the effect of reaction and operating parameters on conversion and product purity.
5. Develop and simulate a batch distillation process and evaluate the effect of reflux ratio, operating time and feed conditions on separation performance.
6. Develop and simulate a bioprocess and analyze the effect of operating parameters on conversion, product formation and process performance.
7. Develop and simulate a crude oil refining process and evaluate the yield and performance of different petroleum fractions.
8. Design and evaluate a heat exchanger using HTFS/EDR and determine the heat-transfer area, heat duty and pressure drop.
9. Develop and analyze a dynamic simulation model and evaluate the process response to changes in operating conditions.
10. Simulate and analyze selected solids operations and evaluate the effect of operating parameters on solids processing performance.
11. Develop and implement a user model and integrate it with MS Excel to analyze and evaluate process data and simulation results.

Software Suggested: ASPEN ONE, ASPEN HYSYS, CHEMCAD, DESIGN-II, gPROM, UNISIM

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Learning chemical simulation softwares (PO-2, 3, 5, 8, 9, 10, PSO-2)

2. Simulate a chemical engineering process. (PO-2, 3, 5, 8, 9, 10, PSO-2, 3)
3. Document and reporting of simulation results. (PO-2, 3, 5, 8, 9, 10, PSO-2, 3)

Reference Books:

1. Haydary, J. (2019). Chemical process design and simulation: Aspen Plus and Aspen Hysys applications. John Wiley & Sons.
2. Hanyak, M. E. (2013). Chemical Process Simulation and the Aspen HYSYS v8. 3 Software. Department of Chemical Engineering, Bucknell University.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test	20	CO1, CO2, CO3
Other Components		
Conduction, Calculation, Record and Viva	30	CO1, CO2, CO3
Semester-End Examination (SEE)	50	CO1, CO2, CO3

SKILL ENHANCEMENT LABORATORY
INTRODUCTION TO SOFTWARE
FOR CHEMICAL ENGINEERS

Course Code: CHL75	Credits: 0:1:1
Pre – requisites: Nil	Contact Hours: 30T+30P
Course Coordinator: Dr. Alex Koshy	

Course Content

Unit 1

Data Analytics with Excel (Tutorial component): Basics of Spreadsheet software (Excel), Introduction to data modeling and analysis using Excel. Basic operations and functions in Excel relevant to chemical engineering. Graph plotting and trendline fitting, Curve fitting for experimental data. Dashboard creation for process monitoring
Lab Component:

1. Introduction to Excel
2. Data Modelling and Data Analysis Using Excel
3. Curve Fitting, Dashboard Preparation using Excel

Unit 2

Application of Excel in Heat and Mass Transfer Operations: Solving heat transfer problems using Excel (conduction, convection, radiation), Mass transfer problems (diffusion, absorption, extraction), Process flow diagrams using Excel, Use of formulas, solver, and macros for chemical processes

Lab Component

4. Heat and Mass Transfer Operation using Excel
5. Analysis and Development of Chemical Process Flow Diagram using Excel

Unit 3

Introduction to Python for Chemical Engineers: Python basics: Syntax, data types, loops, functions, Introduction to NumPy, Pandas, Matplotlib for chemical data analysis, Solving heat and mass transfer problems in Python, Data visualization of chemical processes

Lab Component

6. Introduction to Python, Syntax and Functions
7. Applications of Python Libraries in Chemical Engineering
8. Heat and Mass Transfer operations using Python

Unit 4

Optimization Techniques Using Lingo: Introduction to optimization in chemical engineering, Overview of LINGO software interface and syntax, Linear and nonlinear programming in Lingo, Solving heat and mass transfer problems using LINGO

Lab Component

9. Introduction to Lingo Programming and Optimization
10. Heat and Mass Transfer operations using Lingo

Unit 5

Case Studies and Integrated Applications: Integrated problem-solving using Excel, Python, and Lingo, Case studies in process optimization, equipment design, and process control, Comparative analysis of computational tools for chemical engineering applications, Mini-projects or capstone assignments

Lab Component

11. Case Studies Using Excel/Python/Lingo

Text Book

1. **Martín, M. M. (Ed.)** (2014). *Introduction to Software for Chemical Engineers*. CRC Press.

Reference Books:

1. **Moffat, S.** (2011). *Excel 2010 Advanced*. Bookboon, UK.
2. **McKinney, W.** (2012). *Python for Data Analysis*. O'Reilly Media.
3. **Schrage, L.** (1999). *Optimization Modeling with LINGO*. LINDO Systems Inc.

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Apply fundamental concepts of Microsoft Excel for data handling, analysis, and process modeling in chemical engineering. (PO-1, PO-2, PO-3, PO-4, PSO-1)

2. Develop Python programs to solve engineering problems related to heat exchangers, process equipment, and automation. (PO-1, PO-6, PO-7, PO-9, PO-10, PSO-3)
3. Lingo, integrating statistical and numerical techniques (PO-1, PO-2, PO-3, PO-4 PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test	20	CO1, CO2, CO3
Other Components		
Conduction, Calculation, Record and Viva	30	CO1, CO2, CO3
Semester-End Examination (SEE)	50	CO1, CO2, CO3

VIII SEMESTER

PROJECT WORK	
Course Code: CHP81	Credits: 0:0:13
Pre – requisites: Nil	Contact Hours: -
Course Coordinator: Chemical Engineering Faculty	

Course Content

The group of students carry out an experimental work related to the assigned analytical problem to be carried out under the supervision of the assigned guide. The group of four students shall work with the Guide allocated in the beginning of the semester. The students are required to give three comprehensive presentations on the progress of their project work during the VIII semester and submit the report at the end of the semester. During the semester, performance of the students is evaluated by the guide and project co-ordination committee to award the CIE marks as per the rubrics defined by the committee. The final project report will be evaluated and examined at the end of the VIII semester for SEE.

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Apply critical thinking and quantitative methods to devise innovative engineering solutions to the problems taken in project work. (PO-1,2,3,6,7,8,9,10,11, PSO-1,3)
2. Execute the protocols and perform experimental work with theoretical analysis. Demonstrate ethical integrity and honesty in professional practices. (PO-1,2,3,6,7,8,9,10,11, PSO-1,3)
3. Implement computational analysis and exhibit leadership and strategic vision to execute project objectives. (PO-1,2,3,6,7,8,9,10,11, PSO-1,2,3)
4. Collaborate effectively with diverse teams, leveraging strong interpersonal communication skills. Document precise project report including extensive literature review and present the work progress time to time. (PO-1,2,3,6,7,8,9,10,11, PSO-1,3)
5. Evaluate the sustainability and environmental impact of engineering solutions, ensuring positive societal outcomes. (PO-1,2,3,6,7,8,9,10,11, PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	Marks	Course outcomes attained
Presentation 1	10	CO1, CO2, CO3, CO4, CO5
Presentation 2	15	CO1, CO2, CO3, CO4, CO5
Presentation 3	25	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

RESEARCH / INDUSTRIAL INTERNSHIP	
Course Code: INT82	Credits: 0:0:5
Pre – requisites: Nil	Contact Hours: -
Course Coordinator: Chemical Engineering Faculty	

Course Content

Students should undergo industrial training in the form of Internship for 06 to 08 weeks in reputed industries/ Research organization

Assessment and Evaluation

Students have to undergo 06 to 08 weeks' internship in an industry during the intervening vacation of IV and V or VI and VII semesters. The student has to compulsorily submit a report in his/her VII semester and the evaluation will be done by a committee constituted by the Head of Department as per the rubrics defined by the department.

The prescribed credits shall be included in VIII semester

Course Outcomes (COs):

On successful completion of this course students will be able to

1. Understand functioning of chemical process industry, gain knowledge on the recent developments in the area and integrate theoretical knowledge with practical processes. (PO-2,4,7,11, PSO-1,2,3)
2. Enhance communication skills and work in interdisciplinary teams in industry. (PO-9, 10)
3. Realize professional and ethical responsibility. (PO-6, 7, 8)