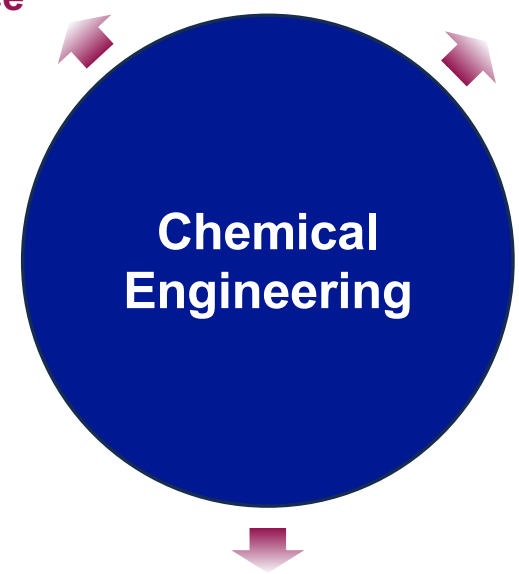
The Philosophy of the Program Design

Chemical Engineering with Integrated Expertise in Data Science

Data Science to Solve Chemical Engineering Problems



Engineers who can Integrate Physical Insight with Data-Driven Intelligence to Design, Operate, and Optimize Complex Chemical Systems

The Curriculum Development Process

Deliberation by the School-Level Committee
(Similar Programs at Other IITs, Foreign Universities*)

**Northwestern University (BS in Chemical Engineering and Data Science)*
University of Illinois (B.S. in Chemical Engineering + Data Science)

Preparation of a Draft Curriculum Proposal
(by the Program Proposal Committee)

Deliberation at the One-Day Workshop
(Expert Panel Consisting of IIT Faculties and Industry Personnel)

Committee:
Dr. Bhaskar Mondal (Chair)
Prof. Prem Felix Siril (Member)
Prof. Aditi Halder (Member)
Dr. Amit B Pawar (Member)
Dr. Narayan Sinha (Member)

Preparation of the Final Proposal
(by the Program Proposal Committee and Chairperson SCS)

The One-Day Workshop

One-Day Workshop
(20th February 2026)

Five Chemical Engineering Experts from IITs
(IITK, IITB, IITM, IITD, IITG)

Two Experts from Industry
(Tata Chemicals and Reliance Industries)

The Day-Long Workshop Deliberated on the **Program Proposal, Curriculum Design, Facility Development,** and **Faculty Recruitment**

Deliberation on the Program Name

Keeping the "**Core**" Chemical Engineering…

The Experts suggested to keep the core name "**Chemical Engineering**" for Industry as well as Govt. job (IOCL, BPCL, etc.) markets, and higher educations (PhD, etc.)

Making the program attractive…

The following name suggestions were deliberated

- B.Tech. in Chemical Engineering and Intelligent Systems
- B.Tech. in Chemical Engineering with Data Analytics
- B.Tech. in Chemical Engineering and Process Analytics
- B.Tech. in Chemical Data Engineering
- B.Tech. in Computational Chemical Engineering
- B.Tech. in Chemical and Process Systems Engineering

B.Tech. in **Chemical Engineering with Data Analytics**

Senate-Approved Intake: 30 Students/Batch

B.Tech. Programs at IIT Mandi

The typical Credit Structure of a BTech Program at IIT Mandi

Division	Sub-Division	B.Tech. Credit
Institute Core (IC)	IC Compulsory	39
	IC Basket	06
	HSS	12
	Indian Knowledge System (IKS)	03
Discipline	Discipline Core	51
	Discipline Elective	15
Electives	Free Electives	22
	MTP + ISTP or Equivalent	12
Total		**160**

Proposed Semester-Wise Curriculum

1st and 2nd Year (Total Credit: 87)			
Semester-I		**Semester-II**	
IC112: Calculus	2	IC114: Linear Algebra	2
IC113: Complex Variables and Vector Calculus	2	IC115: ODE & Integral Transform	2
IC152: Introduction to Python and Data Science	4	IC161: Applied Electronics	3
IC140: Engineering Graphics	4	IC161P: Applied Electronics Lab	2
CEDXXX: Introduction to Chemical Engineering	3	IC252: Probability and Statistics	4
HSS Course	3	IC-II : (IC131: Applied Chemistry for Engineers)	3
Indian Knowledge System (IKS)	3	IC102P: Foundations of Design Practicum	4
		IC222P: Physics Practicum	2
	21		**22**
Semester-III		**Semester-IV**	
IC-I: (ICXXX: Material and Energy Balance)	3	CEDXXX: Discipline Elective 1	3
IC201P: Design Practicum	3	CEDXXX: Chemical Reaction Engineering (2-1-2-4)	4
IC272: Machine Learning	3	CEDXXX: Heat Transfer (2-1-2-4)	4
CEDXXX: Chemical Engineering Thermodynamics	3	CEDXXX: Mass Transfer I (2-1-2-4)	4
CEDXXX: Fluid Mechanics (2-1-2-4)	4	HSS Course	3
CEDXXX: Numerical Methods (3-1-0-4)	4	Free Elective 1	3
HSS Course	3		
	23		**21**

Proposed Semester-Wise Curriculum

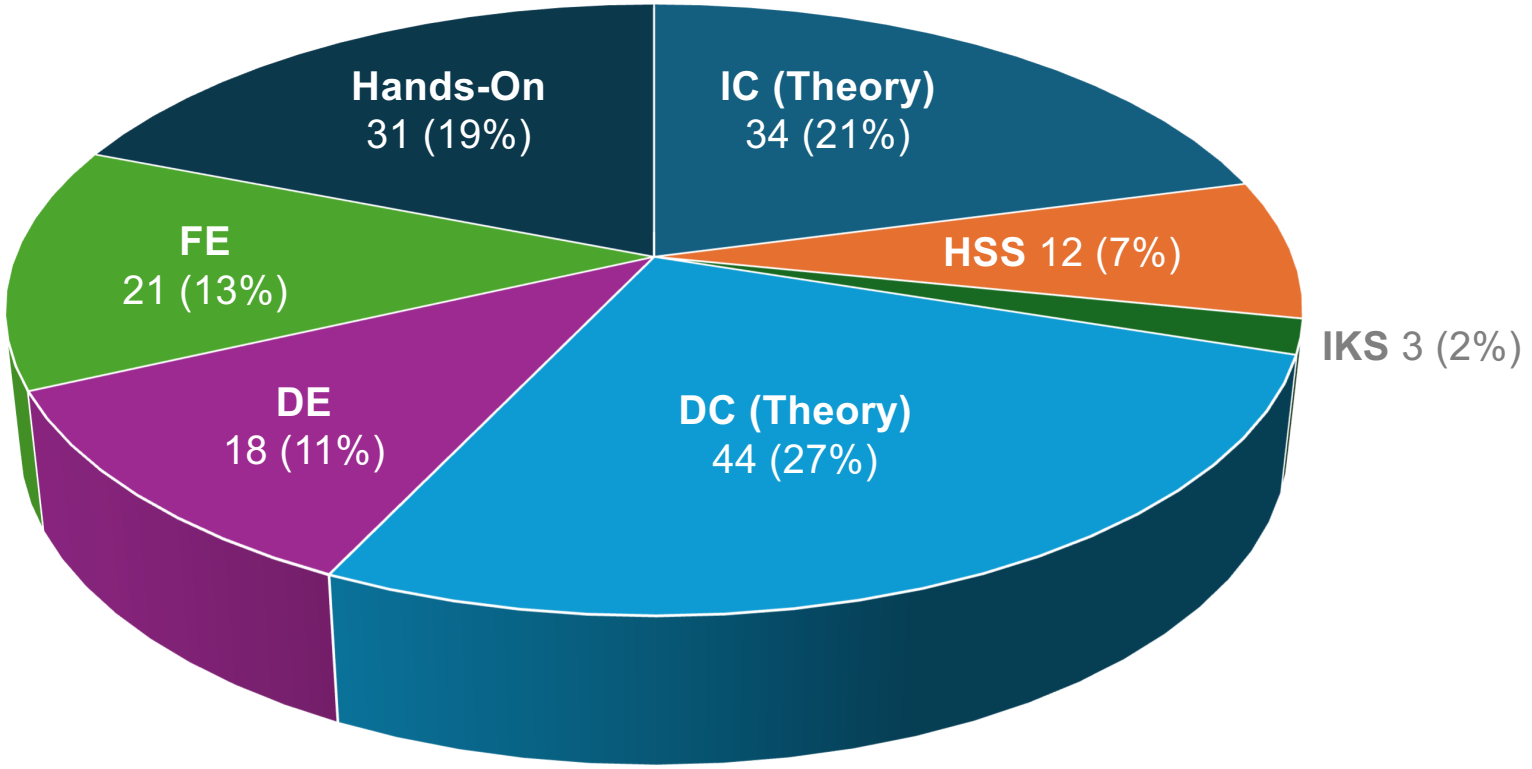
3rd and 4th Year (Total Credit: 76)			
Semester-V		**Semester-VI**	
CEDXXX: Mass Transfer II	3	CEDXXX: Transport Phenomenon	3
CEDXXX: Data Science for Chemical Systems	3	CEDXXX: Digital Process Equipment Design	3
CEDXXX: Process Control & Instrumentation (2-1-2-4)	4	CEDXXX: Chemical Process Technology	3
CEDXXX: Chemical Reaction Engineering II	3	CEDXXX: Discipline Elective 3	3
CEDXXX: Discipline Elective 2	3	CEDXXX: Process Engineering and Economics	3
HSS (Management Course)	3	CEDXXX: Chem Eng Lab (Remaining Exp.)	2
Free Elective 2	3	CEDXXX: Climate Tech & Sustainable Process Eng.	3
	22		**20**
Semester-VII*		**Semester-VIII***	
CEDXXX: Discipline Elective 4	3	Free Elective 4	3
CEDXXX: Discipline Elective 5	3	Free Elective 5	3
Free Elective 3	3	Free Elective 6	3
IC010: Internship	2	Free Elective 7	3
DPXXXP: Undergraduate Research Project I	4	**DPXXXP**: Undergraduate Research Project II	4
	15		**16**

***Industry Visit**: Optional and credit will be adjusted with Free Electives from Semester VII and VIII

Comparison of the Proposed Credit Structure

Division	Sub-Division	B.Tech. Credit	Chem. Eng.
Institute Core (IC)	IC Compulsory	39	39
	IC Basket	06	06
	HSS	12	12
	IKS	03	03
Discipline	Discipline Core	51	56
	Discipline Elective	15	15
Electives	Free Electives	22	21
	Projects/Research/ISTP	12	08
Total		**160**	**160**

Credit Distribution



Hands-On Component will be increased with the following:

- Industry Visit Optional in Free Elective
- Hands-On Component in Discipline Electives

This will increase the overall hands-on component in the curriculum

Tentative Course Topics for **Data Analytics** in ChE

AI for Process Industries

- Advanced Process Control with Reinforcement Learning
- Computer Vision for Quality Inspection
- NLP for Process systems
- IoT and Sensor Networks for Chemical Plants
- Digital Twin Modeling and Predictive Maintenance using AI
- Smart Manufacturing and Industry 4.0

Sustainable ChE + Data

- Data Structure and Algorithms
- Machine Learning for Green Chemistry
- AI Driven Sustainable Process Design
- AI-Driven Energy Transition and Decarbonization
- AI for Carbon Capture and Storage
- Renewable Energy Systems Modeling
- Circular Economy and Process Integration

Students need to complete a total of **21 credits** from the courses of Data Analytics in ChE (DE and/or FE)

Tentative Course Topics for **Data Analytics** in ChE

Materials + Computation

- Molecular Simulation Methods
- Generative AI for Materials Design
- Polymer Informatics and Soft Matter Modeling
- AI for Catalysis and Surface Science
- Multiscale Modeling of Materials
- Formulation Science and Engineering

Data Engineering for ChE

- Time Series Analysis & Forecasting
- Bayesian Methods in Engineering
- Optimization Algorithms for Engineering
- Graph Neural Networks for Molecular Systems
- Cloud Computing and Scalable Data Pipelines
- Database Systems and Management

Students need to complete a total of **21 credits** from the courses of Data Analytics in ChE (DE and/or FE)

Tentative Course Topics for **Data Analytics** in ChE

BioChE + AI

- Bioinformatics and Computational Biology
- AI for Drug Discovery and Design
- Machine Learning for Bioprocess Optimization
- Metabolic Network Modeling and Flux Analysis
- AI-Driven Protein Structure Prediction
- Digital Health and Pharmaceutical Informatics

Engineering Economics + Data

- Techno-Economic Analysis using ML
- Risk Modeling and Decision Analytics
- Supply Chain Optimization for Process Industries
- Financial Modeling for Energy Markets
- Carbon Credit Markets and ESG Analytics
- Project Management and Data-Driven Planning

Students need to complete a total of **21 credits** from the courses of Data Analytics in ChE (DE and/or FE)

Other Topics for Discipline Elective Courses

- Chemical Process Safety
- Chemical & electrochemical reaction engineering
- Catalysis and surface chemistry, electrochemical reaction engineering
- Biological systems engineering
- Biochemical engineering, systems biology
- Process systems engineering
- Advanced process control, state estimation
- Fluid and granular mechanics
- Rheology of complex fluids, special topics in complex fluids
- Soft matter engineering
- Colloids and interfacial engineering, polymer science and engineering
- Thermodynamics and molecular simulations
- Multiscale simulations, computational methods in catalysis
- ….

Potential Job Markets

Career Path

- Core Industrial Jobs (Reliance, HPCL, P&G, SLB N.V., Hindustan Unilever, Dr. Reddy's, Aarati, etc.)
- Non-Core Industrial Jobs (Accenture, Boston Consulting, Goldman Sachs, ICICI, Microsoft, etc.)
- Higher Studies (M.Tech., Ph.D. at Renowned Universities/Institutes)
- Other (e.g., MBA, Entrepreneurship, Civil Services, etc.)

Flexible curriculum and wide exposure will help students pursue diverse career opportunities