APPLICABLE to 2023 UG Batch onwards

Chemical Engineering Course Curriculum

(updated 20 March, 2024)

Semester 1	**B.Tech. Credits = 33**	**Dual Degree Credits = 0**	**Total Credits = 33**
Course Code	**Course Name**	**Category**	**Credits**
CH 111	Chemistry	Basic Sciences and Mathematics	8
CS 101	Computer programming	Engineering Sciences and skills	6
GC 101	Gender sensitization course	Non - Credited compulsory Courses	0
HSS/IDC/ENT	Introduction to HASMED	HASMED Core	8
MA 105	Calculus	Basic Sciences and Mathematics	8
NOCS 01	NCC/NSS/NSO	Non - Credited compulsory Courses	0
PH 117	Physics lab	Basic Sciences and Mathematics	3

Semester 2	**B.Tech. Credits = 33**	**Dual Degree Credits = 0**	**Total Credits = 33**
Course Code	**Course Name**	**Category**	**Credits**
CH 117	Chemistry lab	Basic Sciences and Mathematics	3
CL 102	Material and Energy Balances	Department Core	6
MA 110	Linear Algebra and Differential Equations	Basic Sciences and Mathematics	8
MS 101	Makerspace	Engineering Sciences and skills	8
NOCS 02	NCC/NSS/NSO	Non - Credited compulsory Courses	0
PH 110	Introduction to Classical and Quantum Physics	Basic Sciences and Mathematics	8

Semester 3	**B.Tech. Credits = 36**	**Dual Degree Credits = 0**	**Total Credits = 36**
Course Code	**Course Name**	**Category**	**Credits**
CL 205	AI and Data Science	Engineering Sciences and skills	6
CL 207	Chemical Engineering Thermodynamics	Department Core	6
CL 254	Process Fluid Mechanics	Department Core	6
EC 101	Economics	HASMED Core	6
BB 101	Biology	Basic Sciences and Mathematics	6
ES 250/HS 250	Environmental Studies: Science and Engineering	HS 250 and ES 250	6

Semester 4	**B.Tech. Credits = 36**	**Dual Degree Credits = 0**	**Total Credits = 36**
Course Code	**Course Name**	**Category**	**Credits**
DE 250	Design Thinking	HASMED Core	6
CL 208	Chemical Reaction Engineering	Department Core	6
CL 210	Separation Processes	Department Core	6
CL 242	Fundamentals of Heat and Mass Transfer	Department Core	6
CL 232	Chemical Engineering Lab I	Department Lab and SLP/PT/Works Visit	6
CL 238	Introduction to Numerical Analysis	Department Core	6

Semester 5	**B.Tech. Credits = 33**	**Dual Degree Credits = 6**	**Total Credits = 39**
Course Code	**Course Name**	**Category**	**Credits**
CL 306	Chemical Processes	Department Core	6
CL 327	Chemical Process Design I	Department Core	6
CL 329	Process Control	Department Core	6
CL 333	Chemical Engineering Lab II	Department Lab and SLP/PT/Works Visit	6
	HASMED Elective I	HASMED Elective	6
CL 249	Computational Methods Lab	Department Lab and SLP/PT/Works Visit	3
	Honors Elective I (DD Elective)	Honors/DD	6

Semester 6	**B.Tech. Credits = 36**	**Dual Degree Credits = 6**	**Total Credits = 42**
Course Code	**Course Name**	**Category**	**Credits**
CL 203	Introduction to Transport Phenomena	Department Core	6
CL 331	Chemical Process Design II	Department Core	6
CL 335	Chemical Engineering Lab III	Department Lab and SLP/PT/Works Visit	6
CL 325	Advanced Reaction Engineering	Honors/DD	6
	HASMED Elective II	HASMED Elective	6
	STEM Elective I	STEM Elective	6
	Department Elective I	Department Electives	6

Semester 7	**B.Tech. Credits = 30**	**Dual Degree Credits = 6**	**Total Credits = 36**	
Course Code	**Course Name**	**Category**	**Credits**	
	Department Elective II	Department Electives		6
	BTP I/Department Elective III	BTP/Equivalent Elective courses		6
CL 336	Advanced Transport Phenomena	Honors/DD		6
	STEM Elective II	STEM Elective		6
	Flexible Elective I	Flexible Elective		6
	Flexible Elective II	Flexible Elective		6

Semester 8	**B.Tech. Credits = 30**	**Dual Degree Credits = 6**	**Total Credits = 36**	
Course Code	**Course Name**	**Category**	**Credits**	
	BTP II/Department Elective IV	BTP/Equivalent Elective courses		6
	Department Elective V	BTP/Equivalent Elective courses		6
	Honors Elective II (DD Elective)	Honors/DD		6
	Flexible Elective III	Flexible Elective		6
	Flexible Elective IV	Flexible Elective		6
	Flexible Elective V	Flexible Elective		6

Semester 9	**B.Tech. Credits = 0**	**Dual Degree Credits = 48**	**Total Credits = 48**	
Course Code	**Course Name**	**Category**	**Credits**	
	Dual Degree Project - 1	Dual Degree Project		36
	PG Elective - 1	PG Electives		6
	PG Elective - 2	PG Electives		6

Semester 10	**B.Tech. Credits = 0**	**Dual Degree Credits = 48**	**Total Credits = 48**	
Course Code	**Course Name**	**Category**	**Credits**	
	Dual Degree Project - 2	Dual Degree Project		36
	PG Elective - 3	PG Electives		6
	PG Elective - 4	PG Electives		6

Summary Table

B.Tech. Degree Requirements

Category of Courses	SUM of Credits	Minimum Credits	Maximum Credits	Whether the credits are in the prescribed range?
Basic Sciences and Mathematics	44	32	44	YES
BTP/Equivalent Elective courses	18	18	18	YES
Department Core	72	60	72	YES
Department Electives	12	18	18	NO(This OK since 1 dept elective is converted to 1 core)
Department Lab and SLP/PT/Works Visit	21	18	24	YES
Engineering Sciences and skills	20	20	20	YES
Flexible Elective	30	30	36	YES
HASMED Core	20	20	20	YES
HASMED Elective	12	12	12	YES
HS 250 and ES 250	6	6	6	YES
Non - Credited compulsory Courses	0	0	0	YES
STEM Elective	12	12	12	YES
Grand Total	**267**			

Prescribed Range of Credits for a UG programme is 252 to 276	**Overall credits are in the prescribed range**

Additional Credits for Dual Degree Requirement

Category of Courses	SUM of Credits
Dual Degree Project	72
Honors	24
PG Electives	24
Grand Total	**120**

Prescribed Range of Additional Credits for Dual Degree Requirement is 120 to 124	**Overall credits are in the prescribed range**

Total Dual Degree Credits	**387**

Semester Wise Credit Summary

Semester	B.Tech. Credits	Dual Degree Credits	Total Credits
Semester 1	33	0	33
Semester 2	33	0	33
Semester 3	36	0	36
Semester 4	36	0	36
Semester 5	33	6	39
Semester 6	36	6	42
Semester 7	30	6	36
Semester 8	30	6	36
Semester 9	0	48	48
Semester 10	0	48	48
	267	**120**	**387**

Credit Range

Category	Credits (Min)	Credits (Max)
Basic Sciences and Mathematics	32	44
BTP/Equivalent Elective courses	18	18
Department Core	60	72
Department Electives	18	18
Department Lab and SLP/PT/Works Visit	18	24
Engineering Sciences and skills	20	20
Flexible Elective	30	36
HASMED Core	20	20
HASMED Elective	12	12
HS 250 and ES 250	6	6
Non - Credited compulsory Courses	0	0
STEM Elective	12	12
Grand total	246	282
Prescribed credit limits	252	276

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled **"Separation Processes"**

(Use the attached form for details of Introduction of new course)

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Separation Processes**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **Autumn Semester**
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** Separation processes are ubiquitous in chemical industry. They account for a large fraction of the capital and operating costs of a chemical industry. Chemical engineers must be trained in the working principles of these operations, design and performance analysis of the equipment used to carry out these operations. The course provides fundamental concepts of various mass transfer operations and the common themes of the operations. **Learning outcomes:** At the end of the course, the students should be able to: ● Apply the working principles of the mass transfer operations to solve problems ● Analyze the effects of various parameters on the performance of the operations ● Design the mass transfer equipment to achieve the desired separations
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** Principles and design of the following unit operations: Absorption, distillation, extraction (liquid-liquid and solid-liquid), adsorption, drying, cooling towers, evaporators, crystallization, membrane processes
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references, mention the e-link.* 1. Separation Process Principles, with Applications Using Process Simulators J. D. Seader, E. J, Henley, D. K. Roper, 4th Edition, 2015, Wiley. 2. Diffusion—Mass Transfer in Fluid Systems, E. L. Cussler, 3rd Edition, 2009, Cambridge University Press. 3. Transport Processes and Separation Process Principles, C. J. Geankoplis, A. A. Hersel, D. H. Lepek, 5th Edition, 2018, Prentice Hall.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Madhu Vinjamur (Department of Chemical Engineering) Prof. K. V. Venkatesh (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course:** The contents of the two courses, CL 310 and CL 319, have been combined in the proposed course.

The soft copy (doc & pdf file) of the above course proposal is sent to academic office

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled Not applicable

(Use the attached form for details of Introduction of new course)

(B) For **Revision of the existing course (Course no. and its title)** : **CL 254: Process Fluid Mechanics**

(The course no. will remain same, for (B)

Tick * (√)	**Course No. [Ignore for (A)]**	**Existing [Ignore for (A)]**	**Proposed**
	CL254	√	
	Structure	L : 2 T : 1 P : 0 C : 6	L : 2 T : 1 P : 0 C : 6
	Content	Attached	Attached
	Texts and References (including e-books)	1. R.W. Fox, A.T. MacDonald and P.J. Pritchard, Introduction to Fluid Mechanics Wiley, 2008. 2. J.O. Wilkes, Fluid Mechanics for chemical engineers with microfluidics and CFD, 2nd ed., Prentice Hall, 1998. 3. M.Denn, Process Fluid Mechanics, Prentice Hall, 1979. 4. V.Gupta and S.K. Gupta, Fluid Mechanics and its applications, Wiley, 1984. 5. R.B. Bird, W.E. Stewart and E.N. Lightfoot, Transport Phenomena, 2nd ed., Wiley, 2006.	1. Fox and Macdonald's Introduction to Fluid Mechanics, John W. Mitchell, 10th Edition, 2020, Wiley. 2. Fluid Mechanics for Chemical Engineers Third Edition with Microfluidics, CFD, and COMSOL Multiphysics 5., J.O. Wilkes, Pearson, 2018. 3. Transport Phenomena, R.B.Bird, W.E. Stewart and E.N. Lightfoot, 2nd Edition, Wiley, 2002.
	Type	Core	Core

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022. The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022 **Signature of Convener of DUGC/DPGC/PGC**

To : The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Process Fluid Mechanics**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: Spring semester
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** A few changes have been made to the existing course contents. Fluids are transported in process industry for various purposes. The knowledge of basic concepts of fluid flow, flow through pipes, and the flow past solids is thus essential for chemical engineers. The course intends to provide the knowledge of fluid flow and the equipment used for transportation of fluids. **Learning outcomes:** At the end of the course, the students should be able to: ● Analyze pipe flow under laminar and turbulent conditions and flow meters ● Solve flow problems related to pumps and equipment used for agitation and mixing ● Characterize flows past solids including packed beds, fluidization, sedimentation and filtration
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** ● Review of basic fluid concepts ● Differential Analysis: Review of the Navier Stokes equations, Creeping flow, Stream function, (flow past a sphere, flow in microfluidics devices), Potential flows, Velocity potential, Boundary Layer Theory. ● Application of Integral Analysis: Balances; Bernoulli equation; Flow meters; Pipe flow: f vs Re charts ● Equipment: Piping systems (K factors, networks), Pumps (Types, pump characteristics), Agitation and Mixing, (Power consumption, mixing times, scale up) ● Flow past immersed objects: Packed beds, Fluidised beds, Sedimentation, Centrifugal separation, Filtration), Particulate solids, characterisation,

	Additional topics: Introduction to Turbulent Flows (Reynolds equations), Compressible flows, Compressors, Computational Fluid Dynamics (CFD).
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Fox and Macdonald's Introduction to Fluid Mechanics, John W. Mitchell, 10th Edition, 2020, Wiley. 2. Fluid Mechanics for Chemical Engineers Third Edition with Microfluidics, CFD, and COMSOL Multiphysics 5., J.O. Wilkes, Pearson, 2018. 3. Transport Phenomena, R.B.Bird, W.E. Stewart and E.N. Lightfoot, 2nd Edition, Wiley, 2002
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Devang Khakhar (Department of Chemical Engineering) Prof. Chandra Venkataraman (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course: None.**

The soft copy (doc & pdf file) of the above course proposal is to be sent to academic office

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled Not applicable

(Use the attached form for details of Introduction of new course)

(B) For **Revision of the existing course (Course no. and its title)**: **CL 302: Process Control**

"

(The course no. will remain same, for (B)

Tick * (√)	Course No. [Ignore for (A)]	Existing [Ignore for (A)]	Proposed
			√
	Structure	L : 3 T : 1 P : 0 C: 8	L : 2 T : 1 P : 0 C : 6
	Content	(Add separate sheet)	Attached
	Texts and References (including e-books)	1. Process Dynamics and Control, Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle III, 4th Edition, 2016, Wiley, New Delhi. 2. Process Control: Modeling, Design and Simulation, B.W. Bequette, 2003, Prentice Hall, New Delhi.. 3. Process Modeling Simulation and Control for Chemical Engineers, W.L. Luyben, 2nd Edition, 1990, McGraw Hill. 4. Chemical process control: An Introduction to Theory and Practice, George Stephanpoulos, 2015, Pearson, New Delhi. 5. Kannan M. Moudgalya, Digital control, 2007, Wiley, New Delhi. 6. B. C. Kuo and F. Golnaraghi, Automatic control systems, 9th Edition, 2014, Wiley, New Delhi.	1. Process Dynamics and Control, Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle III, 4th Edition, 2016, Wiley, New Delhi. 2. Process Control: Modeling, Design and Simulation, B.W. Bequette, 2003, Prentice Hall, New Delhi.. 3. Process Modeling Simulation and Control for Chemical Engineers, W.L. Luyben, 2nd Edition, 1990, McGraw Hill. 4. Chemical process control: An Introduction to Theory and Practice, George Stephanpoulos, 2015, Pearson, New Delhi. 5. Kannan M. Moudgalya, Digital control, 2007, Wiley, New Delhi. 6. B. C. Kuo and F. Golnaraghi, Automatic control systems, 9th Edition, 2014, Wiley, New Delhi.
	Type	Core	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022. The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022 **Signature of Convener of DUGC/DPGC/PGC**

To : The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Process Control**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **Autumn Semester**
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** A few changes have been made to the existing course contents The idea of control, and especially feedback control is fundamental and indispensable in chemical engineering. Process control plays an important role in the efficient functioning of the chemical industry. **Learning outcomes:** At the end of the course, the students should be able to: • Derive transfer functions for linear plant models • Predict the dynamic response of linear systems • Design different types of controllers
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Topics:** First principles model development; Process dynamics for first, second and higher order systems: linearisation, Laplace Transform, transfer function models, effect of poles, zeros and time delays on system response; Empirical models from data; control system instrumentation; introduction to feedback control: objectives, PID control; analysis of closed loop systems: stability, root locus, frequency response, Bode and Nyquist plots; control design techniques: design criteria, time and frequency domain techniques, model based design, tuning; advanced control strategies: cascade and feed forward, introduction to multivariable control; controller implementation through discretisation, Z Transform, applications of process control in unit operations and reactors.

10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Process Dynamics and Control, Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle III, 4th Edition, 2016, Wiley, New Delhi. 2. Process Control: Modeling, Design and Simulation, B.W. Bequette, 2003, Prentice Hall, New Delhi.. 3. Process Modeling Simulation and Control for Chemical Engineers, W.L. Luyben, 2nd Edition, 1990, McGraw Hill. 4. Chemical process control: An Introduction to Theory and Practice, George Stephanpoulos, 2015, Pearson, New Delhi. 5. Kannan M. Moudgalya, Digital control, 2007, Wiley, New Delhi. 6. B. C. Kuo and F. Golnaraghi, Automatic control systems, 9th Edition, 2014, Wiley, New Delhi.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Bharat Suthar (Department of Chemical Engineering) Prof. Mani Bhushan (Department of Chemical Engineering) Prof. Sharad Bhartiya (Department of Chemical Engineering) Prof. Sachin Patwardhan (Department of Chemical Engineering) Prof. Ravindra Gudi (Department of Chemical Engineering) Prof. Kannan Moudgalya (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course:** There is some overlap with the contents of the course CL 302: Process Control

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course: Not applicable**

(Use the attached form for details of Introduction of new course)

(B) For **Revision of the existing course (Course no. and its title)**:CL 152: Introduction to Chemical Engineering

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(The course no. will remain same, for (B)

Tick * (√)	**Course No. [Ignore for (A)]**	**Existing [Ignore for (A)]**	**Proposed**
		√	
	Structure	L: 2 T: 1 P: 0 C: 6	L: 2 T: 1 P: 0 C: 6
	Content		
	Texts and References (including e-books)	1. Elementary Principles of Chemical Processes, R. M. Felder and R. W. Rousseau, Lisa G. Bullard, 4th Edition, Wiley, 2015. 2. Basic Principles and Calculations in Chemical Engineering, D. M. Himmelblau, 9th Edition, Pearson, 2022. 3. Stoichiometry, B. I. Bhatt and S. M. Vora, 3rd Edition, 1996, Tata McGraw Hill, New Delhi.	1. Elementary Principles of Chemical Processes, R. M. Felder and R. W. Rousseau, Lisa G. Bullard, 4th Edition, Wiley, 2015. 2. Basic Principles and Calculations in Chemical Engineering, D. M. Himmelblau, 9th Edition, Pearson, 2022. 3. Stoichiometry, B. I. Bhatt and S. M. Vora, 3rd Edition, 1996, Tata McGraw Hill, New Delhi
	Type	Core	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022.
The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022

Signature of Convener of DUGC/DPGC/PGC

To : The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Material and Energy Balances**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **1st Semester** (July-Nov)
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction/ Need for revision:** The existing course CL 152 has been modified slightly to avoid repetition of topics due to the introduction of DIC -1 At the end of the course, the students should be able to: • Solve material and energy balance problems for systems with and without chemical reactions and for systems with recycle, bypass and purge • Calculate vapour-liquid equilibrium for ideal systems • Use equations of state, compressibility charts, psychrometric charts to solve material and energy balance problems
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** Material balances in simple systems involving physical changes and chemical reactions; systems involving recycle, purge. and bypass. Properties of substances: single component & multicomponent, single and multiphase systems. Use of equations of state, compressibility charts, vapour pressure correlations/charts and psychometric charts. Ideal liquid and gaseous mixtures. Energy balance calculations in systems with and without reactions; unsteady state material and energy balances. Additional topics: Principles of balancing with examples to illustrate differential and integral

	balances, lumped and distributed balances. Introduction to Computer aided calculations-steady state material and energy balances.
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Elementary Principles of Chemical Processes, R. M. Felder and R. W. Rousseau, Lisa G. Bullard, 4th Edition, Wiley, 2015. 2. Basic Principles and Calculations in Chemical Engineering, D. M. Himmelblau, 9th Edition, Pearson, 2022. 3. Stoichiometry, B. I. Bhatt and S. M. Vora, 3rd Edition, Tata McGraw Hill, New Delhi, 1996
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Jayesh Bellare and Prof. Sharad Bhartiya (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course: None.**

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course : N.A.**

(B) For **Revision of the existing course (Course no. and its title)** : CL203: Introduction to Transport Phenomena

(The course no. will remain same, for (B)

Tick * (√)	**Course No. [Ignore for (A)]**	**Existing [Ignore for (A)]**	**Proposed**
			√
	Structure	L : 2 T : 1 P : 0 C : 6	L : 2 T : 1 P : 0 C : 6
	Content	(Add separate sheet)	Attached
	Texts and References (including e-books)	Transport Phenomena, R.B.Bird, W.E. Stewart and E.N. Lightfoot, 2nd ed., Wiley, 2002	1. Transport Phenomena, R.B.Bird, W.E. Stewart and E.N. Lightfoot, 2nd Edition, Wiley, 2002. 2. Introductory Transport Phenomena, R. B. Bird, W. E. Stewart, E. N. Lightfoot, D. J. Klingenberg, 2014, Wiley. 3. Fundamentals of Momentum Energy and Mass Transfer, J. R. Welty, G. L. Rorrer, D. G. Foster, 7th Edition, 2019, Wiley.
	Type	Core	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022. The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022 **Signature of Convener of DUGC/DPGC/PGC**

To : The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type:** **Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Introduction to Transport Phenomena**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **3rd Semester** (Aug-Dec)
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** A few minor changes have been made to the existing course contents Transport phenomena is a core chemical engineering course that introduces students to concepts of momentum, energy and mass transfer. This course forms an important pre-requisite to detailed courses on each of these topics later in the UG curriculum. **Learning outcomes:** At the end of the course, the students should be able to: ● Write the differential equations to model transport of mass, momentum and energy for a given process ● Identify the dominant mechanisms that govern transport of mass, momentum and energy, to simplify the differential equations ● Write down the appropriate boundary conditions for the differential equations and solve them ● Identify and apply the non-dimensionless numbers such as Reynolds, Nusselt, Prandtl, Schmidt numbers to solve transport problems ● Perform macroscopic balances, with the appropriate simplifications, for mass, momentum and energy transport
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Course Content:** Introduction: Vectors/Tensors including coordinate transformations and invariants, Physical Meaning of Deformation Rate, Viscosity Shell balance: Falling film, Circular tube Equations of Change for isothermal systems: Continuity, Motion, Energy, Substantial derivatives Dimensional analysis (Buckingam Pi Theorem). Non-dimensionalization of equations of change. Unidirectional flows: Pipe flow, Couette viscometer,

	Macroscopic balances Thermal conductivity and mechanism of energy transport; Shell-energy balances and temperature distributions in solids and laminar flow The equations of change for nonisothermal systems Diffusivity and the mechanisms of mass transport Concentration distributions in solids and laminar flow Introduction to the concept of heat and mass transfer coefficients Additional topics: Variable viscosity falling film, Rotating Sphere, Unsteady flows: Startup Plate flow, Parallel plates Unsteady state conduction Boundary layer theory including analogies
10.	1. Transport Phenomena, R.B.Bird, W.E. Stewart and E.N. Lightfoot, 2nd Edition, Wiley, 2002. 2. Introductory Transport Phenomena, R. B. Bird, W. E. Stewart, E. N. Lightfoot, D. J. Klingenberg, 2014, Wiley. 3. Fundamentals of Momentum Energy and Mass Transfer, J. R. Welty, G. L. Rorrer, D. G. Foster, 7th Edition, 2019, Wiley.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Guruswamy Kumaraswamy (Department of Chemical Engineering) Prof. Hemant Nanavati (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course: None.**

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled **Not applicable**

(Use the attached form for details of Introduction of new course)

(B) For **Revision of the existing course (Course no. and its title)** : **CL 244: Introduction to Numerical Analysis**

_____"

(The course no. will remain same, for (B)

Tick * (√)	**Course No. [Ignore for (A)]**	**Existing [Ignore for (A)]**	**Proposed**
			√
	Structure	L : 3 T : 1 P : 0 C : 8	L : 2 T : 1 P : 0 C : 6
	Content	(Add separate sheet)	Attached
	Texts and References (including e-books)	1. Numerical methods for engineers, by Chapra Steven C., and Canale, Raymond P., 8th Edition, 2021, McGraw Hill. 2. Elementary Numerical Analysis-Kendall Atkinson, Weimin Han, 2004, Wiley. 3. Scientific Computing: An Introductory Survey, Heath M.T., 2nd Edition, 2018- SIAM. 4. Numerical Methods with Chemical Engineering Applications, Kevin D. Dorfman, Prodromos Daoutidis, 2017, Cambridge Series in Chemical Engineering.	1. Numerical methods for engineers, by Chapra Steven C., and Canale, Raymond P., 8th Edition, 2021, McGraw Hill. 2. Elementary Numerical Analysis-Kendall Atkinson, Weimin Han, 2004, Wiley. 3. Scientific Computing: An Introductory Survey, Heath M.T., 2nd Edition, 2018- SIAM. 4. Numerical Methods with Chemical Engineering Applications, Kevin D. Dorfman, Prodromos Daoutidis, 2017, Cambridge Series in Chemical Engineering.
	Type	Core / Department Elective / Institute Elective	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022. The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022

Signature of Convener of DUGC/DPGC/PGC

To: The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Introduction to Numerical Analysis**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **1st Semester** (July-Nov)
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** A few changes have been made to the existing course contents This course covers various numerical methods and algorithms to solve problems (not analytically tractable) encountered in chemical engineering. **Learning outcomes:** At the end of the course, the students should be able to: • Apply numerical methods to: solve a system of linear and non-linear algebraic equations; solve ordinary and partial differential equations; integrate and differentiate functions • Analyze convergence criteria of the numerical methods and select efficient numerical methods based on operation counts and the convergence criteria.
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Topics:** System of linear algebraic equations: direct and iterative methods, convergence criteria, operations count Non-linear algebraic equations: Single variable methods, system of equations, convergence criteria Ordinary differential equations: Initial value problems, explicit and implicit methods, stability, stiffness; boundary value problems, finite difference methods, Partial Differential equations: introduction, semi-discrete and discrete finite difference methods Linear regression Newton and Lagrange Interpolation; Numerical Integration and Differentiation

10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Numerical methods for engineers, by Chapra Steven C., and Canale, Raymond P., 8th Edition, 2021, McGraw Hill. 2. Elementary Numerical Analysis, Kendall Atkinson, Weimin Han, 3rd Edition, 2004, Wiley. 3. Scientific computing_ an introductory survey, Heath M.T., 2nd Edition, 2018- SIAM. 4. Numerical Methods with Chemical Engineering Applications, Kevin D. Dorfman, Prodromos Daoutidis, 2017, Cambridge Series in Chemical Engineering.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Sarika Mehra (Department of Chemical Engineering) Prof. Ratul Dasgupta (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course: None.**

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled **"Introduction to Chemical Engineering"**
(Use the attached form for details of Introduction of new course)

(B) For **Revision of the existing course (Course no. and its title)** : Not applicable

_____"

(The course no. will remain same, for (B)

Tick * (√)	Course No. [Ignore for (A)]	Existing [Ignore for (A)]	Proposed
			√
	Structure	L : T : P : C :	L : 3 T : 0 P : 0 C : 6
	Content	(Add separate sheet)	Attached
	Texts and References (including e-books)		1. The Ascent of Science, by Brian L. Silver, Oxford University Press. 2. The Ascent of Man, by Jacob Bronowski, BBC Books (BBC videos - 13 episodes - are available at: https://www.amazon.com/Ascent-Man-Complete-BBC-Region/dp/B000772842) 3. History of chemical engineering, William F. Furter, editor, advances in chemistry, series 190, American Chemical Society, Washington, D.C.,1980 (All the chapters in the book are available on ACS webpage at: https://pubs.acs.org/doi/book/10.1021/ba-1980-0190) 4. *Scaling Up; The Institution of Chemical Engineers and the Rise of a New Profession*, Colin Duvall & Sean F. Johnston (2000), Kluwer Academic (Dordrecht, Netherlands) ISBN 0-7923-6692-1 5. Chemical Process Technology, Jacob Moulijin, Michiel Makkee, and Annelies van Diepen. Wiley, 2013, ISBN: 97814443202244 (chapter 2: The Chemical Industry) 1. Perspective articles in a series published by *AIChE Journal* 2. Other sources from the internet
	Type	Core / Department Elective / Institute Elective	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022.
The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022 **Signature of Convener of DUGC/DPGC/PGC**

To : The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Introduction to Chemical Engineering**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **1st Semester** (July-Nov)
5.	**Credit Structure: L: 3 T: 0 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** The primary motivation of the course is to generate excitement among the first year undergraduate students for the discipline of chemical engineering. The course is intended to provide a historical perspective on the discipline of chemical engineering, understand its evolution, and highlight the emerging trends. The course will also emphasize the role of various core courses that students will take in the rest of the curriculum. **Learning outcomes:** At the end of the course, the students should be able to: • Summarize the evolution of discipline of chemical engineering • Review important developments and innovations in the discipline • Explain the role of chemical engineering in societal and environmental context • Recognize emerging trends in the discipline
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:**
	• **History of Science and Engineering**
	  ○ Copernican revolution, Galileo versus Church, Kepler and Newton
	  ○ Enlightenment movement followed by Romantic movement & further professionalisation
	  ○ Major developments: Industrial revolution and engines, Electromagnetism, Darwin and Mendel
	  ○ Quantum & Statistical physics
	• **History of chemical engineering discipline**
	  ○ Early examples of chemical process industry (alchemy)
	  ○ Transition from unit operations to unit processes
	  ○ Rise of transport: Unification of heat, mass and momentum transfer
	  ○ Use of computational approaches and adoption of numerical methods to solve integrated problems
	  ○ Attempts to address problems across multiple scales of space and time

	○ Automation in process systems ○ Inclusion of biology and rise of biotechnology/biochemical engineering ○ Consideration of constraints of natural world, shift towards green engineering, integration of concepts and practice of safety management, and design for sustainable operation ○ Process intensification ○ AI/ML driven approach for process modeling and control (availability of data) ○ Climate science (use of transport models to understand climate change) Each of these developments have to be discussed in the context of societal needs. • **Major milestones (discoveries and inventions) and its impact on society:** This portion can begin by explaining the basic structure of a chemical process (combination of reactors, separation systems, utility systems), the concept of value creation. This can be also be brought out as the outcome of the innovations discussed ○ Petroleum refinery and petrochemicals ○ Haber-Bosch process ○ Solvay process ○ Polymer synthesis and manufacturing ○ Nuclear energy ○ Nanotechnology: Transition to smaller scales ○ Biomass as a resource for energy and chemicals ○ Use of renewable resources as inputs • **Chemical industry, environment, and society** ○ Role of societal need in driving innovation ○ Impact of chemical industries on environment and ecosystems ○ Importance of chemical process safety ○ Role of chemical industries in addressing sustainability problems ○ Environmental ethics: Beyond engineering and technology • **Important persons, their biographies, struggle, and success** ○ Innovators ○ Scientists ○ Practitioners
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. The Ascent of Science, by Brian L. Silver, Oxford University Press. 2. The Ascent of Man, by Jacob Bronowski, BBC Books (BBC videos - 13 episodes - are available at: https://www.amazon.com/Ascent-Man-Complete-BBC-Region/dp/B000772842) **3.** History of chemical engineering, William F. Furter, editor, advances in chemistry, series 190, American Chemical Society, Washington, D.C.,1980 (All the chapters in the book are available on ACS webpage at: https://pubs.acs.org/doi/book/10.1021/ba-1980-0190) 4. Colin Duvall & Sean F. Johnston (2000) *Scaling Up; The Institution of Chemical Engineers and the Rise of a New Profession*, Kluwer Academic (Dordrecht, Netherlands) ISBN 0-7923-6692-1 5. Jacob Moulijin, Michiel Makkee, and Annelies van Diepen. Chemical Process Technology, Wiley, 2013, ISBN: 97814443202244 (chapter 2: The Chemical Industry) 6. Perspective articles in a series published by *AIChE Journal* 7. Other sources from the internet
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Sandip Roy (Department of Chemical Engineering) Prof. Santosh Noronha (Department of Chemical Engineering)

12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course: None.**

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled **"Heat and Mass Transfer"**
(Use the attached form for details of Introduction of new course)

(B) For **Revision of the existing course (Course no. and its title)** : Not applicable

_____"

(The course no. will remain same, for (B)

Tick * (√)	**Course No. [Ignore for (A)]**	**Existing [Ignore for (A)]**	**Proposed**
			√
	Structure	L : T : P : C :	L : 2 T : 1 P : 0 C : 6
	Content	(Add separate sheet)	Attached
	Texts and References (including e-books)		1. Fundamentals of Heat and Mass Transfer, Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, 8th Edition, 2017, Wiley. 2. Diffusion—Mass Transfer in Fluid Systems, E. L. Cussler, 3rd Edition, 2009, Cambridge University Press. 3. Heat and Mass Transfer. Fundamentals and Applications 6th Edition - Yunus A. Çengel, Afshin Jahanshahi Ghajar - Mcgraw-Hill Education (2020)
	Type	Core / Department Elective / Institute Elective	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022.
The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022

Signature of Convener of DUGC/DPGC/PGC

To : The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Heat and Mass Transfer**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **Spring semester**
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** Heat transfer and Mass transfer are core subjects of chemical engineering discipline with several aspects having common origins. The course will cover in detail various topics of the heat and mass transfer with an emphasis on their industrial applications. The course will also emphasize the connection with other core courses. **Learning outcomes:** At the end of the course, the students should be able to: • Analyze and solve problems related to: convective heat transfer, radiation, and interfacial mass transfer with and without chemical reactions • Explain the basic forms of the theories of interfacial mass transfer • Design different types of heat exchangers
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** • Intro to heat transfer. A quick review of conduction. • Extended surfaces (variable area, infinite fin) • Unsteady state conduction • Review of natural and forced convection • Film and overall heat transfer coefficients • Convection with phase change: boiling (pool and forced convection boiling) and film condensation • Radiation • Heat exchangers: principles of process design LMTD, shell and tube, double pipe etc., Internal details in a heat exchanger (Baffles, passes on shell and tube side, etc) • Introduction: Review of mass transport concepts • Fundamentals of interfacial mass transfer and theories of mass transfer • Effect of chemical reaction on mass transfer

10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Fundamentals of Heat and Mass Transfer-Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt - 8th edition 2017 -Wiley 2. Diffusion—Mass Transfer in Fluid Systems, E. L. Cussler, , 3rd Edition, 2009, Cambridge University Press 3. Heat and Mass Transfer. Fundamentals and Applications 6th Edition - Yunus A. Çengel, Afshin Jahanshahi Ghajar - Mcgraw-Hill Education (2020)
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Ganesh Viswanathan (Department of Chemical Engineering) Prof. Venkat Gundabala (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course: None.**

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course**

(B) For **Revision of the existing course (Course no. and its title)** : CL 324: Chemical Reaction Engineering

(The course no. will remain same, for (B)

Tick * (√)	**Course No. [Ignore for (A)]**	**Existing [Ignore for (A)]**	**Proposed**
			√
	Structure	L : 3 T : 1 P : 0 C : 8	L : 2 T : 1 P : 0 C : 6
	Content	(Add separate sheet)	Attached
	Texts and References (including e-books)	1. Elements of Chemical Reaction Engineering, H.S.Fogler, 6th Edition, 2022, Pearson. 2. Chemical Reaction Engineering, O. Levenspiel, 3rd ed., 1999, Wiley Eastern. 3. Chemical Engineering Kinetics, Joe Mauk Smith, 3rd Edition, 1981, McGraw-Hill Chemical Engineering Series.	1. Elements of Chemical Reaction Engineering, H.S.Fogler, 6th Edition, 2022, Pearson. 2. Chemical Reaction Engineering, O. Levenspiel, 3rd ed., 1999, Wiley Eastern. 3. Chemical Engineering Kinetics, Joe Mauk Smith, 3rd Edition, 1981, McGraw-Hill Chemical Engineering Series.
	Type	Core	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022.
The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022 **Signature of Convener of DUGC/DPGC/PGC**

To : The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Chemical Reaction Engineering**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **Spring semester**
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** A few changes have been made to the existing course contents Chemical Reaction Engineering (CRE) is a core chemical engineering course that introduces students to concepts of chemical kinetics and reactors. CRE plays a vital role in the design of chemical reactors, which are central to the chemical and petrochemical industries. At the end of the course, students should be able to: ● Analyze kinetics of chemical reactions ● Design chemical reactors with and without a catalyst ● Diagnose reactor malfunctioning using residence time distribution
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Course Content:** Introduction Kinetics of chemical reactions: Elementary and non-elementary reactions Order and rate constant from experimental data Design of batch reactors, ideal CSTR, PFR for systems without and with density changes; for systems with multiple reactions; and for systems with temperature effects. Catalysis: Introduction, mechanisms, kinetics, reactor design Catalyst deactivation: Kinetics, reactor design Residence time distribution: Tracer; experiments, E and F-curves – CSTR, PFR, Laminar flow reactor; diagnostics; PFR/CSTR in series; mixing properties; zero parameter models. Additional topics: One-parameter models

10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Elements of Chemical Reaction Engineering, H.S.Fogler, 6th Edition, 2022, Pearson. 2. Chemical Reaction Engineering, O. Levenspiel, 3rd Edition, 1999, Wiley Eastern. 3. Chemical Engineering Kinetics, Joe Mauk Smith, 3rd Edition, 1981, McGraw-Hill, Chemical Engineering Series
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Abhijit Chatterjee (Department of Chemical Engineering) Prof. Pramod Wangikar (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course:** There is some overlap with the course contents of CL 324: Chemical Reaction Engineering

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled

(Use the attached form for details of Introduction of new course)

(B) For **Revision of the existing course (Course no. and its title)** : CL 306: Chemical Processes

_____"

(The course no. will remain same, for (B)

Tick * (√)	**Course No. [Ignore for (A)]**	**Existing [Ignore for (A)]**	**Proposed**
		√	
	Structure	L : 3 T :0 P : 0 C :6	L : 3 T : 0 P : 0 C : 6
	Content		
	Texts and References (including e-books)	1. Chemical Process Technology, van Diepen, A., Makkee, M., Mouliji, J. A., 2nd Edition, 2013, Wiley 2. Fine Chemicals: The Industry and the Business, Peter Pollak, 1st Edition, 2007, Wiley 3. Fine Chemical Manufacture: Technology and Engineering, Cybulski A., Moulijn J.A., Sharma M.M. and Sheldon R.A., 2001, Elsevier 4. Kirk Othmer: Encyclopedia of Chemical Technology. 5th Edition, Wiley.	1. Chemical Process Technology, van Diepen, A., Makkee, M., Mouliji, J. A., 2nd Edition, 2013, Wiley 2. Fine Chemicals: The Industry and the Business, Peter Pollak, 1st Edition, 2007, Wiley 3. Fine Chemical Manufacture: Technology and Engineering, Cybulski A., Moulijn J.A., Sharma M.M. and Sheldon R.A., 2001, Elsevier 4. Kirk Othmer: Encyclopedia of Chemical Technology. 5th Edition, Wiley
	Type	Core	Core
	Any Other (Please specify)		

* - tick (√) in relevant box where change is proposed.

The above proposal is found to be acceptable by the academic body (DUGC) in its meeting held on 20-Dec-2022. The committee recommended the introduction of the new course for consideration of UGPC.

Date: 20-Dec-2022

Signature of Convener of DUGC/DPGC/PGC

To: The Convener, PGPC/UGPC

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type:** **Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Chemical Processes**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: Spring semester
5.	**Credit Structure: L: 3 T: 0 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** A few changes have been made to the existing course contents The primary motivation of the course is to familiarize students with various production processes that form the core of the chemical process industries. The processes are drawn from various sub-sectors such as Petroleum Refining, Petrochemicals, Specialty Chemicals, Pharmaceuticals, Inorganic Chemicals among others. Processes are analyzed to highlight their unique features and connect them to the concepts studied in other core courses such as Thermodynamics, Reaction Engineering. The course enables students to compare processes in various sectors to identify similarities and differences such as batch vs continuous processing, nature of downstream separation processes. This course serves as a useful survey of various typical process flow sheeting building blocks and motifs which the students can utilize when synthesizing a flowsheet for their design project. **Learning outcomes:** At the end of the course, the students should be able to: ● Draw and describe the production routes for common industrial chemicals ● Critically analyze the need and function of various blocks in a chemical process flowsheet ● Connect process flowsheet features with concepts from thermodynamics, kinetics and other core subjects ● Identify similarities and differences for processes from various sub-sectors of the chemical industry
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** ● Processes in petroleum refining ● Heterogeneous catalytic processes for the manufacture of inorganic and organic chemicals ● Homogeneous catalytic processes

	• Fine and specialty chemical processes • Biotechnology processes
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Chemical Process Technology, van Diepen, A., Makkee, M., Mouliji, J. A., 2nd Edition, 2013, Wiley 2. Fine Chemicals: The Industry and the Business, Peter Pollak, 1st Edition, 2007, Wiley 3. Fine Chemical Manufacture: Technology and Engineering, Cybulski A., Moulijn J.A., Sharma M.M. and Sheldon R.A., 2001, Elsevier 4. Kirk Othmer: Encyclopedia of Chemical Technology. 5th Edition, Wiley.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Madhu Vinjamur (Department of Chemical Engineering) Prof. Sanjay Mahajani (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course: None.**

The soft copy (doc & pdf file) of the above course proposal is sent to academic office on

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled "Chemical Process Design II"

(Use the attached form for details of Introduction of new course)

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Chemical Process Design II**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: Autumn semester
5.	**Credit Structure: L: 1 T: 2 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** This course follows the earlier course, Chemical Process Design I. Process and mechanical design of the equipment, and economic analysis of chemical process are carried out in this course. **Learning outcomes:** At the end of the course, the students should be able to: ● Select and design process equipment based on the process requirement ● Design mechanical aspects of the basic process equipment ● Analyze economics of the chemical process plant ● Relate to the new trends in chemical process design
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: Chemical Process Design I**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** ● **Theory component:** ○ Process equipment selection and design ○ Process economics ○ Sustainability considerations in process design ○ Industrial ecology and circular economy ○ Product design ○ Process intensification ● **Practical component:** ○ Equipment sizing ○ Detailed economic calculations of the process plant ○ Process improvement to achieve economic targets ○ Preliminary life cycle assessment/footprint analysis
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Chemical Process Design, R. Smith, 1995, McGraw Hill 2. Product and Process Design Principles: Synthesis, Analysis and Evaluation, W.D. Seider and J.D. Seader, 4th Edition, 2016, Wiley. 3. Conceptual Design of Chemical Processes, J. Douglas, 1989, McGraw Hill. 4. Plant Design and Economics for Chemical Engineers, M.S. Peters, K.D. Timmerhaus and R. West, 5th Edition, 2003, McGraw Hill.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Sujit Jogwar (Department of Chemical Engineering) Prof. Yogendra Shastri (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course:** The contents of the courses, CL 405, CL 419, and CL 452, have been combined in the proposed course.

Date: 14-Apr-2023 **Signature of the Head of the Academic Unit**

The proposal submitted for this course on 20-Dec-2022 had the following distribution for the lectures (L), tutorials (T) and practicals (P) every week for the six credits: L: 1, T: 0, and P: 4. Based on the UGPC suggestions, the distribution was discussed in DFM held on 12 April 2023 and it has been modified to L: 1, T: 2, and P: 0

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled **"Chemical Process Design I"**

(Use the attached form for details of Introduction of new course)

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Chemical Process Design I**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: Spring Semester
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** The course will build on the fundamentals of several core courses of chemical engineering, and it introduces systematic methods and tools to design a chemical process. The students work on a design project that balances theoretical learning with hands-on/practicals. **Learning outcomes:** At the end of the course, the students should be able to: ● Develop conceptual process design for continuous and batch processes ● Design and simulate separation systems and heat exchanger networks ● Perform preliminary design optimization of chemical processes
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: *** **

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp***>).***

9.	**Contents:** ● **Theory component of the course:** ○ Process design and development

	○ Green chemistry and engineering ○ Process safety ○ Design of batch process ○ Design of separation system and heat exchanger network ○ Optimization of design ● **Practical component of the course:** ○ Project topic selection, scoping, and literature review ○ Process identification and plant sizing ○ Linear mass balances ○ Process flowsheet simulation ○ Development of process flowsheet including reaction and separation system ○ Flowsheet optimization ○ Design of heat exchange network
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Chemical Process Design, R. Smith, 1995, McGraw Hill 2. Product and Process Design Principles: Synthesis, Analysis and Evaluation, W.D. Seider and J.D. Seader, 4th Edition, 2016, Wiley 3. Conceptual Design of Chemical Processes, J. Douglas, 1989, McGraw Hill. 4. Plant Design and Economics for Chemical Engineers, M.S. Peters, K.D. Timmerhaus and R. West, 5th Edition, 2003, McGraw Hill
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Sujit Jogwar (Department of Chemical Engineering) Prof. Yogendra Shastri (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course:** The contents of the two courses, CL 451 and CL 455, have been combined in the proposed course.

Date: 14-Apr-2023 **Signature of the Head of the Academic Unit**

The proposal submitted for this course on 20-Dec-2022 had the following distribution for the lectures (L), tutorials (T) and practicals (P) every week for the six credits: L: 2, T: 0, and P: 2. Based on the UGPC suggestions, the distribution was discussed in DFM held on 12 April 2023 and it has been modified to L: 2, T: 1, and P: 0

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course / Revision of Existing Academic Course

(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For Introduction of a new academic course "Chemical Engineering Thermodynamics"

(Use the attached form for details of Introduction of new course)

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **Chemical Engineering Thermodynamics**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: **Autumn semester**
5.	**Credit Structure: L: 2 T: 1 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** The primary purpose of the course is to introduce and use the principles of thermodynamics. The course is intended to provide both classical heat, work calculations in a mechanical system, as also free energy and equilibrium calculations in a multicomponent, multiphase system, of special relevance to any separation process and various unit operations. **Learning outcomes:** At the end of the course, the students should be able to: • Make mass, energy and entropy balance for any physical and chemical transformation in a batch or a continuous system for deriving heat and work requirements. • Calculate the various thermodynamic properties for both ideal and real systems and mixtures • Analyze and calculate phase and reaction equilibrium in multicomponent systems • Apply the equilibrium calculations to unit operations such as distillation, leaching, extraction
7.	**Name(s) of other Academic units to whom the course may be relevant: None**
8.	**Pre-requisites, if any: NA**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** Volumetric Properties of Fluids Thermodynamic Reversibility; First Law: Steady and Unsteady State Analyses Carnot Cycle and Entropy; Second Law: Steady and Unsteady State Analyses; Statistical Interpretation of Entropy Maxwell Relations, Thermodynamic Properties of Real Fluids Thermodynamic Analysis of Process Devices: Pumps, Compressors, Nozzles, Turbines, etc. Thermodynamics of Ideal Mixtures and Solutions Thermodynamics of Real Mixtures: Use of Partial Molar Properties; Residual and Excess Properties; Fugacity and Activity Coefficients Criteria of Chemical Equilibria/Stability of Thermodynamic Systems Vapour-Liquid Equilibria (Ideal/Non-ideal systems) Liquid-Liquid Equilibria Reaction Equilibria: Homogeneous Reactions **Additional topics** Vapor-Liquid-Liquid Equilibria Solid-Liquid Equilibria Solid-Gas Equilibria
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Introduction to Chemical Engineering Thermodynamics, H. C. Van Ness, M. M. Abbott, J. M. Smith, M. T. Swihart, 9th Edition, 2022, McGraw Hill. 2. Chemical, Biochemical, and Engineering Thermodynamics, S. I. Sandler, 5th Edition, 2017, Wiley. 3. Chemical Engineering Thermodynamics, Y.V.C. Rao, Universities Press, 1997. 4. Chemical Engineering Thermodynamics, R. Balzheiser, M. Samuels, and J. Eliassen, Prentice Hall, 1972.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Hemant Nanavati (Department of Chemical Engineering) Prof. Jhumpa Adhikari (Department of Chemical Engineering) Prof. Ratul Dasgupta (Department of Chemical Engineering) Prof. Rajdip Bandyopadhyaya (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course:** The topics of the two thermodynamics courses, CL 250 and CL 255, have been combined in the proposed course.

The soft copy (doc & pdf file) of the above course proposal is to be sent to academic office

Date: 20-Dec-2022 **Signature of the Head of the Academic Unit**

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Proposal for Introduction of a New Academic Course
(Revised format for use from April, 2018)

Name of Academic Unit: Department of Chemical Engineering

(A) For **Introduction of a new academic course** titled **"AI and Data Science"**
(Use the attached form for details of Introduction of new course)

Introduction of New Academic Course

Autumn (proposal submission by March) / Spring Semester (proposal submission by October)*

*The proposal should be submitted **both** in **hard copy** and **electronic form (doc and pdf file)** using the format as given below. The hard copy is to be sent to the Academic Office and the soft copy be emailed to Jt. Registrar(Academic) <dracad@iitb.ac.in>*

Name of the Academic Unit: Department of Chemical Engineering

1.	**Academic Programme:** *B.Tech.*
2.	**Type: Core**
3.	**Title** *(Limited to 50 characters, including the spaces between the words)***:** **AI and Data Science**
4.	**(i) Duration: Full Semester** **(ii) To be offered normally in**: Autumn Semester
5.	**Credit Structure: L: 3 T: 0 P: 0 C: 6** *(L: lectures, T: tutorials, P: practicals, C: total credits)* *(C = 2(L+T)+P for Full Semester ; C = L+T+0.5*P for Half Semester.* *In case of Studio or other modes, the contact hours may be converted to equivalent L/T/P)*
6.	**Justification / Need for introduction:** AI and Data Science has been proposed as a core course in the new UG curriculum.
7.	**Name(s) of other Academic units to whom the course may be relevant: ---**
8.	**Pre-requisites, if any: ---**

**** - The last date of submission of Course Proposal to the Academic office for consideration of the PGPC/ UGPC is given in the Academic Calendar*** <http://www.iitb.ac.in/newacadhome/toacadcalender.jsp>***).***

9.	**Contents:** **AI and Data Science in Chemical Engineering:** Introduction to supervised learning. What are learning objectives? Motivating examples of the use of AI and Data Science in Chemical Engineering and broad categories of problems in AI. Connections between AI methods and probability/ statistics. **Introduction to Probability:** Sample Spaces and events Probability axioms. Properties of Probability, Counting Techniques. Random Variables. Expectations and Variances. Visualizing PDF: Point plot, PDF, CDF, histogram, binning issues in histogram. Conditional probabilities and conditional expectation. Independence. Important discrete and continuous distributions. Bivariate distributions. Visualization of relationship between two variables: bi-variate histogram, conditional PDFs. Joint Probability distributions. Multivariate Normal Distributions with the

	corresponding mean vectors, variance-covariance matrices and correlation matrices. **Programming Basics:** Python/R introduction **Sampling Distributions:** central limit theorem, sample mean, sample variance, and their distributions. **Parameter estimation:** Point estimates: Maximum Likelihood Estimation, maximum a posterior estimation (regularization), Properties of point estimators: unbiasedness, efficiency, Confidence Interval estimates **Hypothesis testing:** Type 1 and Type 2 errors. Testing for parameters of a normal distribution and for percentages based on a single sample and based on two samples. Introduction to the chi-squared test. The concept of p-value. **Regression/ Classification:** Generalization and model complexity, bias-variance tradeoff. Training, validation, and testing. Classification and regression: Linear regression, Logistic regression, neural networks (as encapsulation of linear and logistic regression), indicate nonlinear extension.
10.	**Texts / References** *(The total number to be restricted to 6 – 8. Web references may be given, especially for e-books. Complete details of Texts/References should be provided.* ***Book:*** *Authors (Initials & Last name), Title, Edition (Optional), Publisher, Year.* ***Journal Articles:*** *Authors (Initials & Last name), Title, Journal name, Volume, Page nos., Year.* ***Web References:*** *Authors/Organization, Title, Year (if available), URL.). For e-references mention the e-link.* 1. Sheldon M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, 5th Edition, Elsevier, 2014 2. Principles and Techniques of Data Science, By Sam Lau, Joey Gonzalez, and Deb Nolan, 2019, available online at https://www.textbook.ds100.org/intro 3. Python for data analysis, Wes Mckinney, O Reilly, 2013 4. Review paper by Venkat Venkatasubramanian, "The promise of artificial intelligence in chemical engineering: Is it here, finally?", AIChE Journal, Volume 65, Issue 2 p. 466-478, 2019 5. Duda, Hart, and Stork, ``Pattern Classification", John Wiley & Sons, 2005.
11.	**Names of Instructors** *(At least one instructor should be a permanent faculty member of IITB. For core courses there should be at least two Instructors)***:** Prof. Sharad Bhartiya (Department of Chemical Engineering) Prof. Mani Bhushan (Department of Chemical Engineering)
12.	**Existing course(s), (offered by the same or other academic units) which have significant overlap with the proposed course:** CL 202: Introduction to Data Analysis has some overlap with the proposed course. However, CL 202 has been removed from the new curriculum.

Date: 14-Apr-2023 **Signature of the Head of the Academic Unit**