SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of **Biotechnology**	LP: BT18601 Rev. No: 00 Date: 29.12.2023
B.E/**B.Tech**/M.E/M.Tech : **Biotechnology** Regulation: **2018A** PG Specialisation : **NA** Sub. Code / Sub. Name : **BT18601 / Chemical Reaction Engineering** Unit : **I**	

Unit Syllabus: **Scope of Chemical Kinetics & Chemical Reaction Engineering (9+3 h)**

Broad outline of chemical reactors; rate equations; concentration and temperature dependence, development of rate equations for different homogeneous reactions. Industrial scale reactors.

Objective: To impart knowledge on chemical reactions, reaction rate theories, rate equations and reaction mechanism.

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Overview of Chemical Reaction Engineering	T1 (1,2); T2 (1-3); R1 (1-3); R3 (3,4)	BB & PPT
2.	Broad outline of chemical reactors	T1 (1,2); T2 (4); R1 (309);	MENTIMETER & PPT
3.	Classification of reactions, Reaction rate	T1 (2-5, 13,14); T2 (4-8); R1(3,4)	BB & PPT
4.	Parameters affecting reaction rate	T1(3), R1(4-5)	BB & PPT
5.	Problems on Reaction rate	T1(6-8)	BB & PPT
6.	Rate Equations: Derivation	T1(13-14); R3(4-10)	BB & PPT
7.	Problems on rate equations	V1	Flipped Classroom
8.	Rate equation – Concentration dependent term	T1(14-26); R1 (42,43)	BB & PPT
9.	Problems (Concentration dependent term)	T1(22-25, 29, 73-74); T2(20-22); R1 (44,45); R4(27-37)	BB & PPT
10.	Rate equation – Temperature dependent term	T1(27-29, 72-73); R1 (44,45)	BB & PPT
11.	Problems (Temperature dependent term)	T1(22-25, 29, 73-74); T2(20-22); R1 (44,45); R4(27-37)	BB & PPT
12.	Industrial Scale Reactors	T2 (10-19); R1(18)	BB & PPT
Content beyond syllabus covered (if any):			

* Session duration: 50 minutes

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Sub. Code / Sub. Name: **BT18601 / Chemical Reaction Engineering**

Unit : **II**

Unit Syllabus : **Ideal Rectors (9+3 h)**

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; Multiple reactor systems; multiple reactions.

Objective: To understand reactor design, to understand design equation for various reactor types and to derive expressions for chemical reactor analysis.

Session No *	Topics to be covered	Ref	Teaching Aids
13	Introduction to reactor design, Isothermal Reactor Design	T1(83-88); T2(140-143)	BB & PPT
14	Constant volume batch reactor	T1(38-66); T2(144-150); R1(26-28)	BB & PPT
15	Variable volume batch reactor	T1(67-72); T2(151-168) R1(29-37, 309-312)	BB & PPT
16	Design equation for batch reactors	T1(91-93); R1(296-308)	BB & PPT
17	Problems on constant volume batch reactor	T1(96-97); R2(2.41-2.118); R3(67-79)	BB & PPT
18	Problems on constant volume batch reactor	T1(96-97); R2(2.41-2.118); R3(67-79)	GOOGLE JAMBOARD
19	Problems on variable volume batch reactor	T1(99-100); R2(2.41-2.118); R3(67-79)	BB & PPT
20	Problems on variable volume batch reactor	T1(99-100); R2(2.41-2.118); R3(67-79)	BB & PPT
21	Recycle reactor and autocatalytic reactions	T1(136-140); T2(200-202) R3(128-136)	BB & PPT
22	Multiple Reactions, Parallel reactions	T1(124-136, 152-169) R1(422-431)	BB & PPT
23	Reaction in series	T1(170-181) R1(422-431)	BB & PPT
24	Problems on reactor in parallel and reactor in series	R2(5.29-5.59) R3(167-178)	BB & PPT

Content beyond syllabus covered (if any): Integral and Differential method for chemical reactor data analysis.

* Session duration: 50 mins

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Sub. Code / Sub. Name: **BT18601 / Chemical Reaction Engineering**

Unit : **III**

Unit Syllabus: **Ideal Flow and Non Ideal Flow (9+3 h)**

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow, Models for non-ideal flow.

Objective: To understand residence time distribution in reactor systems and to understand how to develop models for non-ideal flow systems.

Session No *	Topics to be covered	Ref	Teaching Aids
25	Ideal and Non-Ideal flow characteristics	T1(257-260); T2(767-769); R1(318-324, 453-455)	BB & PPT
26	Residence time distribution (RTD) - chemical reactors	T2(769-770);	ANIMATIONS & PPT
27	E-curve, F-curve, Age distribution of fluid in RTD	T1(260-266); T2(771-776); R1(325-331)	BB & PPT
28	Problems on RTD	T1(267-273); T2(773-774, 779-781); R1(461-465)	BB & PPT
29	Problems on RTD	T1(267-273); T2(773-774, 779-781); R1(461-465)	BB & PPT
30	Models for non-ideal flow	T1(283-316); T2(808-809)	BB & PPT
31	Compartment and Dispersion models	T1(283-316);T2(852-853)	BB & PPT
32	Problems related to flow models	T1(305-309); T2(874-877);	BB & PPT
33	Tanks-in-series model	T1(321-338); T2(848-852)	BB & PPT
34	Problems on Tanks-in-series model	T1(329-332); R3(247-259)	BB & PPT
35	Problems on Multiparameter model	T1(329-332); R3(247-259)	BB & PPT
36	Earliness of Mixing, Segregation and RTD	T1(350-365)	BB & PPT
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

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Sub. Code / Sub. Name: **BT18601 / Chemical Reaction Engineering**

Unit : **IV**

Unit Syllabus : **Gas-Solid, Gas-Liquid Reaction (9+3 h)**

Models for fluid-particle reactions; Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

Objective: To understand the principles on gas-solid, gas-liquid reactions; To solve material and energy balances and problems.

Session No *	Topics to be covered	Ref	Teaching Aids
37	Fundamentals of heterogeneous reactions	T1(369-374); R1(154-170)	BB & PPT
38	Solid catalyzed reactions and rate equations	T1(376-406) R1(191-213)	BB & PPT
39	Problems on rate Equations	T1(376-406) R1(191-213)	GOOGLE JAMBOARD
40	Surface and heterogeneous catalysis	T1(376-406) R1(191-213)	BB & PPT
41	Solid-Gas reaction system	R1(224-238)	BB & PPT
42	Gas-Liquid systems	R1(238-256)	BB & PPT
43	Heterogeneous Catalysis: Kinetics in Porous Catalyst Particles	R1(198-213)	BB & PPT
44	Problems on Multiphase /Heterogeneous reacting systems	T1(407-416)	BB & PPT
45	Problems on Multiphase /Heterogeneous reacting systems	T1(407-416)	BB & PPT
46	Rate of reaction for shrinking spherical particle size	T1(577-586)	BB & PPT
47	Fluid-Particle systems	T1(566-576) R1(512-522)	BB & PPT
48	Problems (Fluid-Particle systems)	T1(566-576) R1(512-522)	BB & PPT
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

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Sub. Code / Sub. Name: **BT18601 / Chemical Reaction Engineering**

Unit : **V**

Unit Syllabus : **Solid Fluid Operations (9+3 h)**

G/L reactions on solid catalysis; Resistances and rate equations; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

Objective: To understand the basics of solid fluid operations and design reactor for production of bio based product**.**

Session No *	Topics to be covered	Ref	Teaching Aids
49	Reactors with suspended solid catalyst	T1(447-451)	BB & PPT
50	Fluidized bed reactors	T1(451-470)	ANIMATIONS
51	Fluidized bed reactors-Derivation	T1(451-470)	BB & PPT
52	Rate equations for G/L reactions on solid catalysts	T1(500-503)	BB & PPT
53	Performance equation – Fluidized bed systems	T1(503-510)	BB & PPT
54	Problems on performance equations	T1(517-518)	BB & PPT
55	Fluid-Fluid reaction kinetics;	T1(523-535); R1(614-618)	BB & PPT
56	Tank reactors	T1(523-535); R1(614-618)	BB & PPT
57	Reactors for fluid-fluid reactions	T1(540-546)	BB & PPT
58	Trickle bed reactor: Three phase reactions	T1(500-503); R1(618-619);	BB & PPT
59	Problems related to fluidized bed reactor system	T1(536-537, 551-562)	BB & PPT
60	Problems related to Trickle bed reactor system & Summary	T1(516-518)	BB & PLICKERS
Content beyond syllabus covered (if any):			

* Session duration: 50 mins

Sub Code / Sub Name: **BT18601 / Chemical Reaction Engineering**

TEXT BOOKS

1. Levenspiel, O. Chemical Reaction Engineering, 3rd Edition, John Wiley, 1999.
2. Fogler, H.S., Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall India, 2006.

REFERENCES

1. Missen, R.W., Mims C.A., Saville B.A. "Introduction to Chemical Reaction Engineering and Kinetics", John Wiley, 1999.
2. Srivastava, R.P.S. Elements of Reaction Engineering, Khanna Publishers, 2000.
3. Gavhane, K.A. Chemical Reaction Engineering, Nirali Prakashan, 2011.
4. Pandey, G.N and Srivastava, S.N. Fundamentals of Chemical Reaction Engineering, Galgotia Publications, 2004.

VIDEO LINKS

1. https://www.youtube.com/playlist?list=PLODKZZeKAWb-PMMqRrD4hNUG4v7bkVbt1

	Prepared by	Approved by
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Designation	Assistant Professor	HOD
Date	29.12.2023	29.12.2023
Remarks *: -		
Remarks *: -		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD