B. Tech. Semester IV

Subject Name: Mechanical Operation **Subject Code: BTCH13401**

Type of course: PCC

Prerequisite (if any): Basic calculations in chemical engineering,

Rationale: This course offers basic understanding of different Mechanical operations like Size reduction and size analysis, Filtration, Fluidization, Agitation, and Mixing etc.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
2	0	2	3	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Solids , Size Reduction & Enlargement:** Characteristics of solids, Solid particles characterization by sieve ananlysis, principle of communition, types of crushers, grinders & disintegrators for coarse, intermediate & fine grinding, types of milling operations with applications in pharmaceuticals and pesticides industry, energy & power requirement, laws of crushers & work index, close & open circuit grinding, size enlargement by agglomeration, briquetting, compacting, granulation and tabletting	8	34%
2.	**Screening & Other Separation Methods:** Types of screens, comparison of ideal & actual screens, capacity & effectiveness of screens, principle of elutriation, floatation, jigging, electrostatic & magnetic separation processes	4	12%
3.	**Sedimentation and Electrostatic Precipitator:** Settling velocities in free & hindered settling, flocculation, rate of sedimentation, types of thickener & thickener area calculation, batch & continuous settling chambers, sorting classifiers, centrifugal settling process,	4	12%

	cyclone, principle of centrifugal sedimentation, working principle and applications of Electrostatic Precipitator.		
4.	**Fluidization:** Mechanism, dense phase fluidisation & boiling beds, minimum porosity of bed & bed height, minimum fluidisation velocity & pressure drop in fluidised beds, applications of batch & continuous fluidisation	4	**12%**
5.	**Filtration:** Types of filters, filter media, filter aids, batch & continuous filtration equipments – filter press, leaf filter, cartridge filter, rotary drum filter, theories of filtration, washing of cake, principle of centrifugal filtration, suspended basket centrifuge, etc.	4	**12%**
6.	**Mixing & Agitation:** fundamentals of mixing & agitation, characteristics of mixing equipments, agitation of liquids, types of impellers, power consumption in agitated vessels in liquid – liquid, liquid – solid & solid – liquid mixing, mixing of pastes & paste masses, pony mixers, beater mixer, mixing of dry powder, ribbon blender, tumbler mixer, etc.	4	**12%**
7.	**Conveying and Storage of solids:** mechanical & pneumatic conveying, elevators, etc. storage of solids, liquids & gases	2	**6%**

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	**25**	**20**	20	10	00

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Unit Operations in Chemical Engineering	Warren L. McCabe, Julian C. Smith & Peter Harriot	McGraw Hill Publications	2004	7^{th}
2	Chemical Engineering Vol. 2	J. M. Coulson & J. F. Richardson	Pergamon International, Great Britain	1984	5^{th}
3	Mechanical Operations for Chemical Engineers	C.M. Narayanan and B.C. Bhattacharya	Khanna Publisher, ISBN: 978-81-7409-036-2	1990	3^{rd}

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Characterize solid particles and perform size reduction of particles to meet the need of chemical industries	20
CO-2	Review the practical importance and relevance of unit operations used for crushing and grinding in chemical industries	20
CO-3	Evaluate the parameters of various filtration equipment and sedimentation	20
CO-4	Comprehend fluid flow through fluidized bed	25
CO-5	Identify the different types of mixing, agitation and conveying of solids and estimating the power requirement	15

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	2	1	1	3	3	3	2	2	2	3	2	2	2
CO-2	3	3	2	1	1	3	3	3	2	2	2	3	2	2	1
CO-3	3	3	2	1	1	3	3	3	2	2	2	3	1	1	1
CO-4	3	3	2	1	1	3	3	3	2	2	2	2	2	2	3
CO-5	3	3	2	1	1	3	3	3	2	2	2	2	2	2	3
Rationale *	3	3	2	1	1	3	3	3	2	2	2	2	2	2	3

Rationale*: Explaining why it is matching this particular program outcome

LIST OF PRACTICALS:

1. To determine the screen efficiency for the given sample by sieve analysis
2. To determine the screen efficiency for the given sample by vibrating screen
3. To determine nip angle, Reduction Ratio, Ribbon Factor, Rittinger's constant, Bond's constant, Kick's constant , Work Index as well as Theoretical & Actual Capacity using roll crusher
4. To determine Rittinger's constant, Bond's constant, Kick's constant and Work Index using jaw Crusher
5. To calculate the overall efficiency of the cyclone separator.
6. To carry out the batch sedimentation tests.
7. To determine critical speed for ball mill

8. To study filter press
9. To determine separation efficiency by using froth flotation cell
10. To study the fluid flow through fluidized bed reactor

Major Equipment:

Jaw crusher, Pulverizer, Roll crusher, Ball mill, Cyclone separator, Plate & Frame filter press, Sieve shaker apparatus etc.

List of Open Source/learning website:

Reference to NPTEL lectures can be made for a better understandingregarding mechanical operation done in industriesunder different conditions.