

## PARTICLE TECHNOLOGY

TYPE	COURSE CODE	NAME OF THE COURSE	L	T	P	CREDIT
ESO	FME221	Particle Technology	3	0	0	9
<b>COURSE OBJECTIVE</b>						
The objective of the course is to learn about the fundamentals of particle characterisation, comminution and classification and get familiarised with the different technologies used, with focus on the equipment, their construction, operation and performance optimization						
<b>LEARNING OUTCOMES</b>						
<p>Upon successful completion of this course, students will have</p> <ul style="list-style-type: none"> <li>the knowledge about the sampling principles and methods as required for various analyses</li> <li>the knowledge of the various properties of particles and their characterisation</li> <li>the understanding of the importance and application of comminution and classification operations in industry</li> <li>the understanding about the underlying principles and phenomena of all relevant size reduction and size separation units used in the industry</li> <li>the knowledge of the construction, operation, application and performance enhancement of industrial size reduction and size separation equipment</li> <li>the information about the performance analysis methodologies and mass and water balancing of industrial comminution-classification circuits</li> </ul>						
NO.	TOPICS TO BE COVERED	HOURS	LEARNING OUTCOME			
1	<b>Introduction:</b> Definition of mineral, rock, ore, gangue, tenor. Unit operations, conceptual flow diagram to represents sequence of material in plants. Particle properties and their relevance to mineral processing	3	Familiarisation with the fundamentals of mineral engineering			
2	<b>Sampling:</b> Definition, need, methods of sampling (solids and slurries), Gy's law of sampling, estimation of minimum amount of sample required, BIS standard for sampling, accurate sampling of solids and slurry	3	Knowledge of the principles and standard methods used for the collection of solid, liquid and slurry samples			
3	<b>Particle size and size distribution:</b> Geometrical diameters, equivalent or derived diameters, statistical diameters to designate the size of the irregular particles, in sieve and sub-sieve sizes, and their measurement techniques Particle size distribution and quantification, different methodologies <b>Size distribution functions:</b> Gaudin-Schumann, RosinRammler, Gaudin-Meloy, Broadbent and Calcott	4	Knowledge of the concept of size and its different definitions and of the various methods applied for their measurement, representation and interpretation of size distribution data			
4	<b>Surface area and shape measurement:</b> Direct and indirect methods, permeability, gas adsorption, Volume and porosity measurements, Bulk solids properties – bulk density, true density.	2	Knowledge of the various methods applied for the measurements of surface area and shape of particles and other bulk properties			
5	<b>Basics of size reduction:</b> Fundamentals of size reduction, modes of fracture comminution laws, drop shatter tests and shatter index, single particle breakage and packed bed breakage; basic principles of crushing and grinding. grindability indices	3	Understanding of the meaning, scope and importance of comminution and mechanism of comminution, with knowledge of the relevant material testing techniques			
6	<b>Crushing:</b> Construction & operational features of different crusher: objectives, forces of breakage; design, operation and maintenance of jaw, gyratory, cone, single and double roll crushers, sizers, hammer mills, ring granulators and rotary breakers, high compression rolls. performance aspects. in-pit and portable crushers	7	Familiarisation with the different crushing equipment used in the industry, their construction, operation, merits, demerits, operational and design parameters and their performance analysis			
7	<b>Grinding:</b> Principles, construction & operational features of grinding mills: ball, rod, pebble, autogenous, sag and fluid energy mills, mills used in power plants and cement industry; mill liners; feed entry and product discharge mechanisms; open- and closed-circuit grinding; application of mills; effect of process parameters on mill performance	7	Familiarisation with the different milling equipment and techniques used in minerals, power and cement industries, their construction, operation, merits, demerits, and operational and design parameters			
8	<b>Industrial screening:</b> Need and importance of size separation, fundamentals of industrial screening; dry and wet screening; classification of screens; different types of industrial screens. pre-scrubbing and other processes to improve screening efficiency. Screen performance measurement, factors affecting screen performance.	5	Understanding the principles and mechanism, need and scope of screening and knowledge about the different types of industrial screens, their applications, construction, operation, important factors and performance analysis			

9	<b>Classification:</b> Settling of solids in fluids, settling velocities for Stokesian and Newtonian conditions, Reynolds number and its application, settling ratios. Different types of classifiers used in mineral industry: Hydrocyclones, Mechanical Classifiers, Efficiency of classifiers; Solids and water balance calculations.	8	Understanding the principles of classification in fluids and familiarisation with the different industrial classifiers, their construction, operation, important factors, performance analysis and circuit balancing
<b>Total</b>		<b>42</b>	<b>Lecture</b>

TEXT BOOKS			
NO.	RESOURCE/BOOK NAME	AUTHOR(S)/EDITOR(S)	PUBLISHER
1	Wills' Mineral Processing Technology	Barry A. Wills James Finch	Butterworth-Heinemann
2	Introduction to Mineral Processing	Errol G. Kelly, David J. Spottiswood	John Wiley and Sons
3	Introduction to Particle Technology	M. Rhodes	John Wiley & Sons Ltd.
REFERENCE BOOKS			
NO.	RESOURCE/BOOK NAME	AUTHOR(S)/EDITOR(S)	PUBLISHER
1	Mineral Processing Design and Operation: An Introduction	A. Gupta and D.S. Yan	Elsevier
2	Mineral Processing Plant Design	Andrew L. Mular, Roshan Boman Bhappu	Society of Mining Engineers (AIME)