

Course code	Course Name	L-T-P - Credits	Year of Introduction
MT203	MINERAL BENEFICIATION	3-1-0-4	2016
<b>Prerequisite: Nil</b>			
<b>Course Objectives</b> <ul style="list-style-type: none"> <li>To impart knowledge of various raw materials; identification, selection, handling and processing of ores</li> <li>To familiarise with metallurgical analysis techniques.</li> </ul>			
<b>Syllabus</b> Mineral Processing- Steps in mineral processing - Quantitative representation of mineral processing operations - Liberation, Comminution, Sizing and Classification - Theory and practice of mills- Laboratory and industrial screening - Classifiers-Mineral Separation Processes - Quantifying concentrating operations -Physico-Chemical Separation Processes -Magnetic and Electrostatic Separation - Floto-flocculation for treating waste water - Simplified Beneficiation Flow Sheets of Coal and Ores of Metals			
<b>Expected Outcome.</b> Upon completion of the course, the student will be able to: <ol style="list-style-type: none"> <li>Understand the importance of mineral liberation, and principles and processes of crushing, grinding, and size classification (screens, hydrocyclone, classifiers)</li> <li>Understand the fundamentals of sampling, gravity, magnetic, electrostatic, and forth flotation separation</li> <li>Apply mass balance principle to determine plant stream flows</li> <li>Learn Stokes' and Newton's law for particle movement in liquid</li> <li>Analyze forces (centrifugal, gravitational, buoyant, viscous, magnetic, electrostatic, etc) acting upon a particle in different processes and their effects on separation performance</li> <li>Learn various methods of evaluating classification and separation processes</li> </ol>			
<b>References/Textbooks</b> <ol style="list-style-type: none"> <li>Jain. S. K., Mineral Processing, CBS Publishers&amp; Distributors P Ltd, New Delhi</li> <li>Ramakrishna Rao. G.S, Mineral Processing Techniques, Zorba Publishers Pvt Ltd</li> <li>Joseph Newton, Extractive Metallurgy, John Wiley &amp; Sons Inc</li> <li>Gaudin. A. M, Principles of Mineral Dressing , Tata McGraw Hill,</li> <li>Gilchrist. J.D, Extraction Metallurgy, Pergamon Press</li> <li>Barry Wills, Tim Napier- Munn, Wills' Mineral Processing Technology, Elsevier Science &amp; Technology Books</li> </ol>			
<b>Course Plan</b>			
Module	Contents	Hours	Sem. Exam Marks
I	<b>Introduction to Mineral Processing</b> 1.1Introduction and scope of mineral processing in extractive metallurgy, 1.2 Mineral and Ore- definitions, Mineral resources in India, 1.3 Physical and chemical characteristics and classification of minerals, 1.4 Choice of mineral processing methods- Methods based on properties of minerals, 1.5 Steps in mineral processing, Quantitative representation of mineral processing operations, recovery, ratio of concentration, efficiency of ore processing operation, economic recovery. 1.6 Pre-treatment and sampling of ores: Breaking and sampling of ores, Weighing, Washing and Scrubbing, Hand and mechanical sorting	9	15%

II	<b>Liberation, Comminution, Sizing and Classification</b> 2.1 Liberation and its significance, 2.2 Comminution and sizing, Laboratory sizing and equipments, Laws of Comminution, 2.3 Crushing and Grinding- types and equipment, crushing and grinding laws (Kick and Rittinger laws), Crushing and grinding efficiency, practical measures of grinding efficiency, crushing resistance of minerals. Recent developments in crushing and grinding methods. 2.4 Washing, Sorting and hand-picking, 2.5 Theory and practice of ball mills, types of ball mills, rod mill, pebble mill, tube mill, tumbling mill, Hadsel mill, disintegration by internal forces, 2.6 Laboratory and industrial screening- equipment, Operating characteristics of screens, factors affecting screening efficiency, 2.7 Classifier- mechanical and hydraulic, sizing and sorting classifiers.	10	15%
<b>FIRST INTERNAL EXAMINATION</b>			
III	<b>Mineral Separation Processes</b> 3.1 Principle and operation of shaking tables, Wilfley tables, Dry tables, 3.2 Types of Jigging – hand jig, fixed screen jig, movable screen jig, pneumatic jig, advantages and limitations of jigs. 3.3 Gravity concentration in vertical currents:- Theory of flowing film concentration. Devices for flowing film concentration- devices with stationary and moving separating surfaces, 3.4 Heavy fluid separation (dense media separation DMS):- Introduction, mechanism, types of media, cleaning and recirculation of media, operation of heavy fluid separation, Lab use of heavy fluids, 3.5 Industrial DMS processes using heavy liquids- Lessing process, Bertrand process, Du Pont Process. Industrial DMS processes using heavy suspensions- Chance process, Vooys process, Wuench process, Huntington-Heberlein sink – float process, differential density process, Akins process, counter current dense media separator, Stripa process, Wemco process, heavy media separation in cyclones, Dry fluid bed separator. 3.6 Dewatering techniques, Thickener, Filtration and Drying. 3.7 Quantifying concentrating operations: screen and classifier efficiencies	11	15%
IV	<b>Physico-Chemical Separation Process</b> 4.1 Physico-Chemical principles, 4.2 Reagents like collectors, modifiers and frothers. 4.3 Chemical processing of ores:- Mechanism and methods of Leaching, Ion exchange, Solvent extraction, Roasting, Sintering. 4.4 Recovery of gold by cyanide and amalgamation processes. 4.5 Treating of Nickel oxide, Uranium, Thorium ores, 4.6 Chemical beneficiation of ilmenite and concentrating Manganese ores. 4.7 Auxiliary operations:- Storage, Conveying, Feeding, Sampling, Weighing. 4.8 Process variables in floatation, Study of flow sheet for floatation of sulphide ores	10	15%
<b>SECOND INTERNAL EXAMINATION</b>			
V	<b>Magnetic and Electrostatic Separation</b> 5.1 Movement of solids in fluids:- Elementary concepts of movement of solids in fluids, 5.2 Fluid resistance and terminal velocity, 5.3 Settling of fine spheres and Stoke's law, settling of coarse spheres and Newton's law, settling particles of intermediate		20%

	range, factors affecting theoretical treatment of falling particles, Reynold's number, equal settling of particles, 5.4 Settling of large spheres in a suspension of fine spheres, hindered settling (effect of simultaneous movement of many particles) 5.5 Magnetic and electrical separation:-Mechanism of magnetic separation, 5.2 Minerals responding to magnetic separation, 5.3 Magnetic separators – Dry and wet methods, Demagnetization, 5.4 Electrical methods:-Mechanism, Conductivity of minerals, 5.6 Electrical separation processes, Electrostatic and high tension separators, Dielectric separation method. 5.7 Solid-fluid separation:-Thickening, flocculation- mechanism and factors affecting, sedimentation and dewatering of floccules, thickening equipments. Solid and disc filters, centrifugal and electrophoretic filters. Dust elimination from air / gases, Water removal. Floto-flocculation for treating waste water.	11	
<b>VI</b>	<b>Simplified Beneficiation Flow Sheets of Coal and Ores of Metals</b> 6.1 Beneficiation flow sheets of coal and simple ores of copper, lead, zinc, Iron and with reference to Indian deposits.	5	20%
<b>END SEMESTER EXAM</b>			

### QUESTION PAPER PATTERN:

Maximum Marks : 100

Exam Duration: 3 hours

**PART A:** 8 Questions from Module 1&2 (4+4). 6 questions to be answered. 6x5=30 Marks

**PART B:** 8 Questions from Module 3&4 (4+4). 6 questions to be answered. 6x5= 30 Marks

**PART C:** 6 Questions from Module 5&6 (3+3). 4 questions to be answered. 4x10=40 Marks

