



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mining Engineering

Subject Code: DI04022091

Subject Name: Mineral Beneficiation

w. e. f. Academic Year:	2025-26
Semester:	4 <sup>th</sup>
Category of the Course:	Professional Elective - II

<b>Prerequisite:</b>	Must have sufficient knowledge of course Mine Sampling, Assaying and Mineral Dressing
<b>Rationale:</b>	This course covers the principles and applications of mineral beneficiation to improve ore value through advanced processing techniques. It focuses on optimizing recovery, reducing waste, and ensuring industry standards. Students gain skills in separation technologies, plant design, and sustainable beneficiation practices, preparing them for professional roles in mineral processing and resource utilization.

## Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes	RBT Level
01	Explain the need and importance of mineral beneficiation.	R, U
02	Describe comminution and mineral liberation techniques.	R, U, A
03	Apply suitable methods for mineral concentration.	R, U, A
04	Explain dewatering and drying processes in beneficiation.	R, U, A
05	Identify modern and sustainable beneficiation practices.	R, U, A

*\*Revised Bloom's Taxonomy (RBT)*

## Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2) C	Assessment Pattern and Marks				Total Marks
L	T	PR		Theory		Tutorial / Practical		
			ESE (E)	PA (M)	PA (I)	ESE (V)		
3	0	2	4	70	30	20	30	150



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## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>Introduction to Mineral Beneficiation:</b> 1.1 Need and scope of mineral beneficiation 1.2 Objectives and stages of beneficiation 1.3 Economic importance of beneficiation 1.4 General layout of a beneficiation plant	06	13
2.	<b>Comminution and Liberation Techniques</b> 2.1 Introduction to Comminution: 2.1.1 Definition and purpose of comminution 2.1.2 Importance of size reduction in beneficiation 2.1.3 Stages of size reduction – crushing and grinding 2.1.4 Energy requirement and efficiency in size reduction (basic concept only) 2.2 Conventional Methods for Comminution (Crushing, Grinding, Screening and Classification) 2.3 Mineral Liberation 2.3.1 Definition and significance of mineral liberation 2.3.2 Relationship between particle size and degree of liberation 2.3.3 Effects of over-grinding and under-grinding 2.3.4 Methods of determining liberation (simple microscopic observation) 2.3.5 Importance of proper liberation in concentration efficiency 2.4 Advanced energy-Efficient Comminution Methods (Introductory Level): 2.4.1 High-Pressure Grinding Rolls (HPGR) – principle and advantages 2.4.2 Stirred media mills – concept and use in fine grinding 2.4.3 Basic introduction to automation in comminution circuits	10	22
3.	<b>Concentration (Separation) Methods</b> 3.1 Introduction to Concentration: 3.1.1 Purpose and importance of mineral concentration 3.1.2 Difference between concentration and comminution 3.1.3 Criteria for selecting separation methods (based on physical properties: density, magnetic susceptibility, surface properties, etc.) 3.2 Conventional Methods for Separation (Gravity separation, Magnetic separation, Froth Flotation) 3.3 Advanced Methods for Separation (Basic Concept and use in modern beneficiation system with example): 3.3.1 Electrostatic separation 3.3.2 Optical sorting method	12	27



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	3.3.3 Sensor based separation 3.4 Comparison and Selection of methods: 3.4.1 Comparative advantages and limitations of gravity, magnetic, and flotation methods 3.4.2 Flow sheet examples showing combination of methods for specific ores		
4.	<b>Dewatering and Drying</b> 4.1 Introduction to Dewatering: 4.1.1 Need and importance of dewatering in mineral beneficiation 4.1.2 Different stages of dewatering: 4.1.2.1 Thickening - Principle, types of thickeners, Mechanism, Flocculation 4.1.2.2 Filtration - Principle, types of filters, Filter media, Factors affecting filtration efficiency 4.1.2.3 Drying – Principle, Purpose, types of dryers 4.1.3 Moisture content and its effect on handling and transport of concentrate 4.2 Water Recycling and Environmental Considerations: 4.2.1 Importance of water recovery and reuse in beneficiation plants 4.2.2 Effluent treatment and management of process water 4.2.3 Environmental aspects of tailings disposal and moisture control 4.3 Modern Trends in Dewatering (Introductory Level) 4.3.1 Use of automatic control systems in thickening and filtration 4.3.2 Filter aids and polymer applications 4.3.3 Energy-efficient drying technologies	11	25
5.	<b>Emerging Trends and Sustainable Practices</b> 5.1 Eco-friendly beneficiation methods 5.2 Waste management and tailing disposal 5.3 Automation and use of sensors in beneficiation 5.4 Safety and environmental aspects in beneficiation plants	06	13
<b>Total</b>		<b>45</b>	<b>100</b>

### Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
<b>40</b>	<b>40</b>	<b>20</b>	<b>0</b>	<b>0</b>	<b>0</b>

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



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## References/Suggested Learning Resources:

### (a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Principles of Mineral Dressing	A.M.Gaudin	Tata McGraw-Hill Publishing Company Ltd. Year: 1971 ISBN- 0-07-099821-1
2	Wills' Mineral Processing Technology	Barry A. Wills, T.J. Napier Munn	Butterworth – Heinemann Year: 2006 ISBN-13: 978-0750644501
3	Mineral Processing	S.K.Jain	CBS Publication, New Delhi Year: 2019 ISBN-13: 978-8123907536
4	Textbook Of Mineral Processing	D.V. Subba Rao	Scientific Publishers, New Delhi Year: 2017 ISBN-13: 978-9386347992

### (b) Open-source software and website:

1. NPTEL(IIT-Kharagpur),  
[https://www.youtube.com/watch?v=MtqugJcsHZs&list=PLbRMhDVUMngdzwQyMgoUgdaGBqi\\_p4nVM](https://www.youtube.com/watch?v=MtqugJcsHZs&list=PLbRMhDVUMngdzwQyMgoUgdaGBqi_p4nVM)
2. Introduction To Mineral Processing - IITKGP  
[https://www.youtube.com/watch?v=kJyxtDXjRuc&list=PLiD-g5sRdKdW5mGyyLc38A2KOFUt\\_z8AX](https://www.youtube.com/watch?v=kJyxtDXjRuc&list=PLiD-g5sRdKdW5mGyyLc38A2KOFUt_z8AX)
3. Wikipedia- Mineral processing  
[https://en.wikipedia.org/wiki/Mineral\\_processing](https://en.wikipedia.org/wiki/Mineral_processing)
4. Lecture notes of Mineral Beneficiation  
[https://archive.nptel.ac.in/content/storage2/courses/113104060/lecture10/10\\_2.htm](https://archive.nptel.ac.in/content/storage2/courses/113104060/lecture10/10_2.htm)
5. Canada's Largest Supplier of Mineral Processing Equipment  
<https://www.seprosystems.com/mineral-processing-introduction/>
6. Elsewer- Life Cycle Assessment for Sustainable Mining  
<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/beneficiation>
7. Lecture notes of Mineral Processing  
[https://kp.kiit.ac.in/pdf\\_files/02/Study-Material\\_Mineral-Prossesing\\_3rd-Meta.pdf](https://kp.kiit.ac.in/pdf_files/02/Study-Material_Mineral-Prossesing_3rd-Meta.pdf)
8. PPT- Mineral Beneficiation  
<https://www.slideshare.net/slideshow/mineral-beatification/79496763>
9. NMDC Ltd.- Beneficiation of Minerals and Ores  
<https://www.nmdc.co.in/r-and-d-centre/technical-capabilities/beneficiation-of-minerals-and-ores>
10. Pre-feasibility report of SCREENING CUM BENEFICIATION PLANT OF Bailadila iron ore deposit-4  
[https://environmentclearance.nic.in/writereaddata/Online/TOR/24\\_Jan\\_2022\\_11232938788281553finalPFR.pdf](https://environmentclearance.nic.in/writereaddata/Online/TOR/24_Jan_2022_11232938788281553finalPFR.pdf)



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## Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Crush the given ore sample using a jaw crusher and find its size reduction.	II	4
2	Grind the given ore sample using a Ball mill and find its size reduction.	II	4
3	Determine concentrate, middlings, and tailings using a laboratory jig and to evaluate the efficiency of separation.	III	6
4	Calculate percentage moisture using drying and weighing method of a concentrated sample.	IV	8
5	Calculate drying time versus moisture reduction and determine drying rate curve.	IV	8
			<b>30 Hours</b>

## Suggested Project List:

1. Prepare process flow sheet for beneficiation of assigned ore type.
2. Poster presentation on advanced gravity or flotation methods.
3. Case study on tailings management and environmental control.
4. Seminar on automation and sensor-based ore sorting in beneficiation.
5. Comparative study of beneficiation techniques for metallic vs. non-metallic minerals.

## Suggested Activities for Students:

1. Attend expert lectures on beneficiation plant operations.
2. Field visit to mineral processing or coal preparation plant.
3. Group discussion on modern trends in beneficiation (e.g., sensor-based sorting).
4. Watch NPTEL lectures: *Introduction to Mineral Processing* (IIT Kharagpur).
5. Participate in lab-based mini projects and simulation exercises.

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