GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Metallurgy

Course / Subject Code: DI02021021

Course / Subject Name : Mineral Processing

w. e. f. Academic Year:	2024-2025
Semester:	2nd
Category of the Course:	PCC

Prerequisite:	N.A.
Rationale:	Mineral processing is both an art and science focused on extracting valuable minerals from ores and minerals extracted from the Earth's crust. As ore grades continue to decline, the demand for skilled metallurgy and mining engineers is growing. Mineral processing involves liberating valuable minerals from waste materials through comminution and then separating them using various concentration methods. To produce metals economically and commercially, mineral processing plays a crucial role in efficiently exploiting a country's natural ore reserves. Therefore, this subject is essential for students studying metallurgy.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Corelate minerals on the basis of their properties and uses.	U
02	Use crushing and grinding operations for comminution of the ores.	A
03	Select appropriate sizing, classification and separation process as per requirement.	A
04	Suggest relevant practices to be adopted for sustainable development of mineral processing.	U

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

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

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	1.1 Sources of metals 1.2 Compare ores, minerals and metals 1.3 Physical & chemical characteristics of minerals 1.4 Need of mineral processing 1.5 Flowsheet of mineral processing	03	15
2.	2.1 Laws of comminution i.e. Rittinger's law, kick's law, bond's law 2.2 Crushing definition 2.3 Classification of crushers 2.4 Primary crushers: jaw crusher, gyratory crusher 2.5 Secondary crushers: cone crusher, roll crusher 2.6 Special crushers: Toothed roll, Hammer crusher	08	20
3.	3.1 Grinding definition 3.2 Classification of tumbling mills 3.3 Factors influencing the capacity of a tumbling mill 3.4 Ball mill 3.5 Variables in ball mill 3.6 Rod mill 3.7 Autogenous grinding	05	20
4.	4.1 Purpose of sizing 4.2 Sieve analysis 4.3 Stationary screens, moving screens, vibrating screens 4.4 Classification techniques: sedimentation, elutriation 4.5 Types of Classifiers, Centrifugal Classifier	04	15
5	5.1 Gravity concentration method i.e. Jigging, tabling, heavy-media separation 5.2 Froth flotation 5.3 Magnetic separation 5.4 Electrostatic separation 5.5 Dewatering: Drying, Thickening and Filtration 5.6 Agglomeration: Sintering, Pelletizing	08	20
6	6.1 Sustainable development in mineral processing 6.2 Challenges related to sustainable development in mineral processing	02	10
	Total	**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	40	35	0	0	0

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

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Mineral Processing: (Including Mineral dressing, Experiments and numerical)	Vandana Rao, Sonam Patel, Avinash Lele	I. K. International Publishing House Pvt. Ltd., New Delhi, 2017, ISBN 978-9385909504
2	Principle of Mineral Dressing	Gaudin A.M.	McGraw-Hill Inc., US, 1939 ISBN-978-0070230309
3	Extraction Of Nonferrous Metals	H. S. Ray, S. Sridhar, K. P. Abraham	Affiliated East-west Press Pvt Ltd., 2008, ISBN 978-8185095639
4	Handbook of Mineral Dressing; Ores and Industrial Minerals	Arthur F. Taggart	John Wiley & Sons, 1945, ISBN 978-0471843481
5	Wills' Mineral Processing Technology	Barry A. Wills	Butterworth-Heinemann, 2006, ISBN 978-0750644501
6	Mineral Processing	S. K. Jain	CBS, 2001, ISBN 978-8123907536
7	Principles of Mineral Processing	Maurice C. Fuerstenau, Kenneth N. Han (Editor)	Society for Mining, Metallurgy, and Exploration, 2003 ISBN 978-0873351676
8	Textbook of Mineral Processing	D. V. Subba Rao	Scientific Publishers, New Delhi, 2017 ISBN 9789387741027
9	Environmental Impact of Mining and Mineral Processing Management, Monitoring, and Auditing Strategies	Ravi K. Jain, Zengdi Cindy Cui, Jeremy K. Domen	Butterworth-Heinemann, Elsevier, USA, 2016 ISBN 978-0128040409

(b) Open-source software and website:

1. https://mg-nitk.vlabs.ac.in/exp/identification-of-minerals/
2. https://www.prit.ac.in/virtual-labs
3. https://www.youtube.com/watch?v=aj6otFQMUvA
4. https://www.britannica.com/technology/mineral-processing
5. https://www.youtube.com/channel/UCUiup4A7jGvAgE_4kdD0yxg
6. https://www.youtube.com/watch?v=hUcrKHgglRk
7. https://www.youtube.com/watch?v=7ZLsF8LRuMQ
8. https://savree.com/en/encyclopedia/ball-mill
9. https://www.youtube.com/watch?v=jJeKGdy-Eds
10. https://www.youtube.com/watch?v=dmR3NgEj_vo
11. https://www.youtube.com/watch?v=IlbGScXeMjs
12. https://www.youtube.com/watch?v=E2Ln8KgrhpA

Suggested Course Practical List:

No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify minerals on the basis of colour, hardness and density.	I	04
2	Demonstrate the principle, construction and working of the jaw crusher.	II	04
3	To study the working principle, operation, and performance of a roll crusher and determine its reduction ratio and efficiency.	II	06
4	Perform ball mill grinding operations on given a given mineral and calculate critical speed of ball mill.	III	06
5	To determine the particle size distribution of a given material using sieve analysis.	IV	06

6	To study the jig's principle, construction, and working for gravity-based particle separation.	V	06
7	To study the principle, construction, and working of a magnetic separator for particle separation.	V	06
8	To perform the tabling process for the concentration of the given mineral.	V	06
9	Demonstrate Froth floatation process.	V	06
10	To study the effect of water content on pelletizing characteristics of a given mineral powder.	V	06
Total		**56**	

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications
1	Different types of Minerals Set
2	Moh's Hardness Kit
3	Density measurement instrument
4	Jaw Crusher Crusher size: 4" to 12" Feed size: 25 mm to 90 mm Discharge size: 5 mm to 30 mm Capacity: 150 to 500 kg/hr
5	Ball Mill Jar capacity: 2 to 10 kg Grinding ball material: Stainless steel/Hardened steel Grinding jar material: Stainless steel/Hardened steel Movement: One way
6	Sieve shaker Sieve material: Brass or stainless steel Sieve size: 3" to 12" Mesh size range: 75 µm to 9.5 mm or as per ASTM E11 Capacity: 0.05g to 10 kg

7	Jig Separator and Heavy Media Separator
8	Magnetic Separator Drum size: Ø 300 – 400 mm and 200 to 350 mm width Rotating speed: 5 to 30 RPM
9	Wilfley Table
10	Laboratory Disc pelletizer Disc material: Stainless steel Disc angle: 45° Disc speed range: 5 to 50 RPM Pellet size: 1 mm to 20 mm

Suggested Project List:

1 Measure hardness of different minerals on Mohs scale and compare it.

2 Map the location of minerals available in India and around the world.

3 Collect minerals of different metals and prepare a report.

4 Apply sizing operation on a mineral.

5 Make the agglomerates of mineral and characterized it.

6 Make a report on environmental impact of mining and mineral processing.

Suggested Activities for Students:

1. Make a model on the basis of physical and chemical properties of different minerals.
2. Draw flowchart of mineral processing operations.
3. Draw flowchart for beneficiation process of a mineral
4. Compare crushers on the basis of their industrial applications.
5. Compare ball mill, rod mill, pebble mill and tube mill on the basis of their industrial applications.
6. Industrial visit of mineral processing industries.
7. Group discussion on advanced mineral processing operations.