GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Mining Engineering

Course / Subject Code: DI03022051

Course / Subject Name: Mine Sampling Assaying & Mineral Dressing

w. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	PCC

Prerequisite:	To study Mine Sampling, Assaying, and Mineral Dressing course in a Diploma in Mining Engineering, students should have a foundational understanding of basic chemistry, physics, and mathematics, as these subjects are essential for grasping material properties and processing techniques. A basic knowledge of geology and mining fundamentals is also important to understand ore types and mining operations. Additionally, laboratory and fieldwork skills are helpful for practical applications in sampling and mineral processing.
Rationale:	To predict the economic valuation of any mineral deposit, it is very much important to know the grade value of the mineralization of whole mine area, which is varying in nature from one point to another, for this purpose a huge number of sampling work is required in mining projects. A sound knowledge of grade variation will solve the continuing associated problems of mine evaluation, planning, operations and production scheduling. A high degree of expertise in all aspects of this subject is essential requirement for professional success of a diploma mining engineering in any mining industry. Similarly its also become important to aware the students about the advent of new technology in mineral dressing and beneficiation processes. The mining engineers are responsible for locating mineral rich area by exploration sampling, by calculation of grade values, ore reserves estimation, and concentration of mineral applying various ore beneficiation techniques. This course will improve the required skills of students to achieve the targeted outcome of the course.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes	RBT Level
01	Select suitable method of sampling with all safety and limitations.	R, U
02	Estimate ore reserve with its grade value for mine valuation.	R, U, A
03	Select suitable size reduction process and machine as per the need.	R, U, A
04	Adopt suitable mineral dressing process to improve concentration of mineral.	R, U
05	Design a flow sheet of coal beneficiation process.	R, U, A

**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		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Mine Sampling :** 1.1 Definition: - Specimen, Sample, Sampling and Salting. 1.2 Difference between a sample & a specimen. 1.3 Purpose, Importance and various uses of sampling in mines. 1.4 Sampling methods with its applicable conditions. (Channel sampling, Chip sampling, Grab sampling, Bore hole sampling, Bulk sampling and Wagon sampling) 1.4 Needs and Methods of Reduction of sample. (Coning & Quartering, Rolling, Decimating & Splitting) 1.5 Precautions taken while collection of samples. 1.6 Sources of errors in Sampling. 1.7 Salting-(Intentional and unintentional) Purpose and Precautionary measures against salting.	07	16
2.	**Assaying & Mine Valuation :** 2.1 Definition: - Assay map, Assay plan factor, Assay values, Grade value, Tenor of ore and different types of ore grade. 2.2 Calculations based on average assay value and average grade of ore. 2.3 Ore reserve estimation methods : - 2.3.1 Geometric method - Included area method, Extended area method, Triangle method and polygonal method. 2.3.2 Graphic method – Use of Isochore maps, use of stratum contour and use of transverse section.	12	26

	2.3.3 Economic considerations for reserve estimations. 2.3.4 Guiding principles in reserve estimations. 2.4 Mine Valuation: - 2.4.1 Factor affecting in the process of mine valuation. 2.4.2 Risk involved in mine valuation. 2.4.3 Valuation reports of mine. 2.4.4 Net present value of Mine:- Hoskold's Formula and Morkill Formula		
3.	**Size reduction of mineral** 3.1 Comminution/ Size reduction – Definition, Purpose and Objective of comminution/ size reduction. 3.2 Types of Crushers : - 3.2.1 Primary crusher:- Jaw crusher and Gyratory crusher - Constructional features, working mechanism and reduction ratio. 3.2.2 Secondary crusher:- Cone crusher and Roll crusher- Constructional features, working mechanism and reduction ratio. 3.2.3 Tertiary crusher:- Ball mill with it's critical speed, Hammer mill and Rod mill- Constructional features, working mechanism and reduction ratio.	10	22
4.	**Mineral Dressing & Concentration Techniques** 4.1 Scope, objectives and advantages of mineral dressing. 4.2 Definition of associated terms in mineral dressing. 4.3 Process of mineral dressing and concentration techniques: - 4.3.1 Size Liberation / Screening:- Purpose, Types, Screen efficiency. 4.3.2 Gravity concentration methods:- Jigging operation, Methods of Jigging, Advantages and disadvantages of jigs, Factors affecting in stratifications of Jigging:- Hindered settling, Differential acceleration and Consolidation trickling. 4.3.3 Heavy media separation:- Principle and working mechanism, Types of heavy media used. 4.3.4 Froth floatation Process:- Principle of operation, working mechanism, preparation of mineral pulp, aeration and froth	12	26

	formation, adsorption, contact angle, collectors, frothers & activators. 4.3.5 Magnetic separation:- Principle and working mechanism (Dry and wet separation). 4.3.6 Electrostatic separation:- Principle and working mechanism, Conductivity of minerals and factors affecting the electrostatic separation. (Belt and Role type separators).		
5.	**Coal Beneficiation** 5.1 Purpose and objectives of coal beneficiation. 5.2 Dry coal beneficiation process. 5.3 Wet coal beneficiation process. 5.4 Simplified flow sheet of coal beneficiation. 5.5 Flow sheet of coal washing plant & Coal washing plant-features.	04	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
29	**55**	**16**	**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	Mine Economics	Arvind Kumar	Lovely Prakashan, Dhanbad
2	Mine And Mineral Economics	Subhash C. Ray, Indra N. Sinha	PHI Learning Publisher, Delhi ISBN: 978-8120351745
3	Principles Of Mineral Dressing	A.M.Gaudin	McGraw – Hill Inc., US. Year: 1939 ISBN-13: 987-0070230309
4	Wills' Mineral Processing Technology	Barry A. Wills, T.J. Napier Munn	Butterworth – Heinemann Year: 2006

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
			ISBN-13: 978-0750644501
5	Mineral Processing	S.K.Jain	CBS Publication, New Delhi Year: 2019 ISBN-13: 978-8123907536
6	Textbook Of Mineral Processing	D.V. Subba Rao	Scientific Publishers, New Delhi Year: 2017 ISBN-13: 978-9386347992
7	Mineral Processing (Including Mineral Dressing, Experiments and Numerical Problems)	Vandana Rao, Sonam Patel, Avinash Lele	Dreamtech Press, New Delhi Year – 2020 ISBN-13: 978-9389633214

(b) Open-source software and website:

1) NPTEL MOOC Course – Introduction To Mineral Processing by IIT Kharagpur
https://www.youtube.com/@introductiontomineralproce3372

2) Mine Sampling -

Part 1: https://www.youtube.com/watch?v=X7sNG5FR0oM
Part 2: https://www.youtube.com/watch?v=0O40bWArItg
Part 3: https://www.youtube.com/watch?v=yqgh1KM1qJc&t=8s
Part 4: https://www.youtube.com/watch?v=SdpHtk6Usww&t=365
Part 5: https://www.youtube.com/watch?v=t3n9wGKL1aA&t=90s

3) Assaying & Mine Valuation –

Part 1: https://www.youtube.com/watch?v=MKagoBMMj2I
Part 2: https://www.youtube.com/watch?v=QNpUqG9zW9Q
Part 3: https://www.youtube.com/watch?v=AfatnNYkJuM
Part 4: https://www.youtube.com/watch?v=77S68M1YREY
Part 5: https://www.youtube.com/watch?v=aaIdp_9ra3U

4) Size reduction of mineral –

Part 1: https://www.youtube.com/watch?v=1Rq1F1i7BN4

Part 2: https://www.youtube.com/watch?v=_Pi6LAFRJ9c
Part 3: https://www.youtube.com/watch?v=Lv7rNtag2pc
Part 4: https://www.youtube.com/watch?v=kbe05JrXbJs
Part 5: https://www.youtube.com/watch?v=-oDT3gkEMIo
Part 6: https://www.youtube.com/watch?v=_4fAHK2L7jM
Part 7: https://www.youtube.com/watch?v=RE4ACl7TC-I
Part 8: https://www.slideshare.net/sandeepdahiyasaini1/rod-mill-74815388
Part 9: https://www.youtube.com/watch?v=1r1ZOmbOczk

5) Mineral dressing & Concentration techniques –

Part 1: https://www.youtube.com/watch?v=-93raWtLjso
Part 2: https://www.youtube.com/watch?v=MsIhdVOTCkM
Part 3: https://www.youtube.com/watch?v=jJeKGdy-EDs
Part 4: https://www.youtube.com/watch?v=yNbDyOJa76Y
Part 5: https://www.youtube.com/watch?v=udjMJl2emY4
Part 6: https://www.youtube.com/watch?v=C8qVlNms0ac
Part 7: https://www.youtube.com/watch?v=D1k7Rl4FJJw
Part 8: https://www.youtube.com/watch?v=FijQNxs0dhw
Part 9: https://www.youtube.com/watch?v=eG4b0N1uhEM
Part 10: https://www.youtube.com/watch?v=Nx-kh9Q1Vsk

6) Coal beneficiation –

Part 1: https://www.youtube.com/watch?v=Kx-jpJsj0rM
Part 2: https://www.youtube.com/watch?v=fZ6VjKrrm4

Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Prepare a specimen representative sample from run off mine material applying reduction techniques,	I	02
2	Estimating ore reserve using the triangle area geometric method.	II	04
3	Reduce size of given rock sample by Jaw crusher and find reduction ratio of crushing.	III	04

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
4	Perform ball mill grinding on various rock samples and plot a graph showing effects of grinding with time.	III	04
5	Perform size liberation operation of given rock sample by various screen and plot a graph between screen size and input, output.	IV	04
6	Concentration of given sample of mineral by Jigging operation and analyze the result.	IV	06
7	Separate magnetic mineral by magnetic separation method and study effect of magnetic field on efficiency of the process.	IV	04
8	Draw a simplified flow sheet of coal beneficiation process.	V	02
			30 Hrs.

Suggested Project List:

1. Prepare a poster showing various sampling techniques for various rock formation.
2. Prepare an illustration banner related to precautions and safety during collection of sample.
3. Presentation on any case study related to collection of mine sampling.
4. Prepare a poster showing machines involved in primary, secondary & tertiary crusher.
5. Make slides showing various principals used behind working of concentrators.
6. Draw a schematic diagram of froth floatation process.
7. Prepare a chart showing types of heavy media used for various mineral separation as per specific gravity.
8. Prepare an illustration sheet showing various graphical methods of ore reserve estimation.
9. Draw a flowsheet of coal washing plant.

Suggested Activities for Students:

1. Expert lecture on following topics : Mine Sampling, Assaying & Mine Valuation, Size reduction of mineral, Mineral dressing & concentration techniques and Coal beneficiation.
2. Visit of nearby mineral dressing plant of mining industry.
3. Case study on mineral concentration techniques.
4. Group discussion on advance mineral dressing & concentration techniques.
5. Case study on issues associated with mine sampling and mitigational measures.
6. Undertake project list.

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