GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Mining Engineering

Subject Code: BE03022031

Course / Subject Name: Development of Mineral Deposits

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

Prerequisite:	Nil
Rationale:	The development of mineral deposits is essential for meeting global resource demands, driving technological innovation, and generating economic benefits. However, it also requires sustainable resource management practices, technological innovation, and social responsibility to minimize environmental and social impacts.

Course Outcome:

After Completion of the Course, the Student will able to:

No	Course Outcomes	RBT level
1	Students will be able to describe and classify different types of mineral deposits and its significance.	Understand
2	Students will understand the principles and techniques of drilling and blasting to reach up to mineral deposits.	Apply
3	To apply the concept of horizontal and vertical development networks to develop mines.	Apply
4	To understand the principles and techniques of surface mining with sustainable development.	Apply

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Course Content:

Unit No.	Content	No. of Hours	% of Weightage

1.	**Introduction**: - history, discovery, evaluation, types, and present status of mineral deposits; Classification and Comparison of Mining; Indian mining industries and their status; Excavation systems to exploit coal and non-coal deposits; cyclic and continuous methods of development and their comparison.	04	20
2.	**Drilling:** Introduction to drilling and drilling equipment used in opencast and underground mines, selection of drill, applications, motive power, operating components, Mechanics of rock penetration, etc. **Blasting:** Classification and comparative properties of explosive; General application and uses; Blasting theory; Mechanisms of rock blasting; Blasting devices; Electric and non-electric methods; Delay blasting techniques; Priming; Charge distribution; Blasting with cut and solid blasting, Blasting practices in underground and surface mines; Safety considerations.	14	30
3.	**Mine access or Modes of Entry:** A brief introduction to modes of primary access, choice of modes of entry - adit, shaft, decline, and combined model; their applicability and comparison. **Horizontal Development:** Drifts and Tunnels, Purpose, shape, size, and location; driving work in varying ground conditions using conventional methods – drilling, blasting, mucking, transportation, supports, services, and cycle of operations. Application of mechanized methods, road headers, and tunnel boring machines. **Vertical Development:** Location of shaft, shape and size, incline and vertical shafts. Surface arrangements for sinking shafts, tools, and equipment, ordinary methods of sinking, drilling, blasting, removal of debris and water, ventilation and lighting, and temporary and permanent lining. Widening and deepening of shafts, the modern techniques of shaft sinking/boring. Raise and winze and its applications, classifications, techniques, Conventional method, mechanical method, blast hole method, Raise borers, etc.	18	30
4.	**Surface Development:** Brief description of elements of an opencast mine: ramp, haul roads, benches, opening through box cut, drilling and blasting, intermediate and continuous method of excavation, production cycle, dumping of overburden, and backfilling.	09	20
	Total	**45**	**100**

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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**30**	**40**	**10**	**-**	**-**

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:

1. Surface and Underground Excavations (2nd Edition) by Ratan Raj Tatiya, CRC Press.
2. Elements of Mining Technology by D. J. Deshmukh Part I, II & III, Denett
3. Universal Mining School (Part I and II) by T. A. Southern, H. W. Halbaum, UMS
4. Surface Mining Technology by S. K. Das, Lovely Prakashan
5. A Study of Metalliferous Mining methods by Y. P. Chacharkar, Lovely Prakashan
6. Introduction to Mining by Howard L. Hartman and Jan M. Mutmansky, Wiley
7. Engineering Rock Blasting Operations, by Sushil Bhandari, A.A. Balkema
8. Drilling and Blasting of Rocks, by C. Lopez Jimeno, E. Lopez Jimeno, Francisco Javier Ayala Carcedo, CRC Press
9. Drilling Technology Handbook, by Chandra Prakash Chugh, Oxford & IBH Publisher, 1977.
10. Rock Blasting Effects and Operations by Pijush Pal Roy, CRC Press; 1st edition, 2005.

(b) Open source software and website:

1. https://shorturl.at/Q2mQp
2. https://ibm.gov.in/IBMPortal/pages/Indian_Minerals_Yearbook
3. https://shorturl.at/cg1uT
4. https://shorturl.at/7kye6
5. https://www.sgu.se/en/itp308/knowledge-platform/chapter-9-ore-deposit-geology/
6. https://miningandblasting.wordpress.com/about/
7. https://crmining.com/mining-drill/
8. https://groundhogapps.com/high-precision-drilling-mining-gps/

9. https://shorturl.at/AhN9U

Suggested Course Practical List:

1. To understand types of mine entries.
2. To understand the drilling and drilling techniques applied for the development of mines.
3. To understand the properties of explosives, types and their applicability in mines.
4. To understand the primary and secondary blasting techniques.
5. To understand the blasting practices in underground and surface mines.
6. To understand the development of drift by conventional and mechanized methods.
7. To understand the development of shafts by conventional and mechanized methods.
8. To understand the development of raise by conventional and mechanized methods.
9. To understand the elements of surface mines.
10. To understand the development of mine by intermediate and continuous methods.

List of Laboratory/Learning Resources Required:

1. Samples of Ore deposits.
2. Drilling accessories used in the mining of mineral deposits
3. Sample of explosive cartridge and blasting accessories.
4. Mine model of underground and open-cast coal with labeled terminologies.
5. Metalliferous mine model of the underground and open cast with labeled terminologies.
6. Model of the cycle of operation carried out during the development of mineral deposits.
7. Model of various mine accesses to reach up to mineral deposits.

Suggested Project List:

1. Prepare a poster with a picture depicting the terms used in the opencast coal mines.
2. Prepare a poster with a picture depicting the terms used in the underground coal mines.
3. Prepare a poster with a picture depicting the terms used in the opencast metalliferous mines.
4. Prepare a poster with a picture depicting the terms used in the underground metalliferous mines.
5. Prepare a poster on the list of explosives in detail.
6. Prepare poster blasting accessories used in opencast and underground blasting.

Suggested Activities for Students: If any

1. Visit open cast and underground coal mines and prepare the report.
2. Visit open cast and underground metalliferous mines and prepare the report.
3. Present a presentation on any topic related to the subject curriculum.

- **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5hrs., Report preparation = 5hrs.	Based on report submitted. Report should contain

		Total = 10hrs.	observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 4hrs. each. Total = 20hrs.	Based on the correctness of submittedassignment.
4.	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB, modeling and Analysis software or any other software	5 small coding-based assignment of 2hrs. each. Total = 10hrs.	Based on the coding solution submitted.
5.	Self-learning online course	Minimum duration of the course should be 10hrs.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Identification and solution of Complex problem	Maximum 2 problems. Study of the problem and solution finding, Total = 10hrs.	Based on the depth of the solution submitted.
7	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on quiz/report submitted
8	Technical paper reading and summarization of research papers based on relevant subject	5 research papers = 20 hrs.	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 hrs.	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 hrs. Non- working = 8 hrs.	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide	Duration = 15 hrs. for industrial exposure	Based on evaluation of critical problems and solutions

	tentative solutions on society/environment/ health/sustainability/ any other issue	Problem identification and tentative solution = 10 hrs. Total = 20 hrs.	
12	Group Discussion on emerging/trending technical topics based on subject	Duration = Min. 1 hr.per subject. Max. 3 hrs. per subject	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 hrs.	Depending on the complexity of the Application/Software
15.	Research paper publication	Duration = 10 hrs.	Based on submission of proof of publication
16.	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10 hrs.	Based on the performance of the equipment
17.	Expert lecture/session	Duration 3 hrs. For attending the lecture/session– 2 hrs. and for report writing 1 hr.	Based on the proof of attendance and report submitted
18.	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
19.	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:

- All the suggested activity should be related to the subject.
- The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.

- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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