GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022

Semester-III

Course Title: Mining Machineries-I

Course Code: 4332202

Diploma program in which this course is offered	Semester in which offered
Mining Engineering	Third

1. RATIONALE

Mining is a complex and challenging process requiring specialized equipment to extract a huge amount of valuable and non-valuable minerals from below the earth surface. The grade values of mineral is segregated in nature, the geological conditions are also varying from place to place. So, for achieving a targeted high grade production a keen knowledge of specialized heavy duty standard excavating and transporting equipment is required to be implemented in mines to achieve maximum profit.

For designing a perfect layout of an underground or surface mine a proper selection of excavating equipment matching with the transport equipment is very much essential. The transport machineries should be selected depending upon the loading capacity of excavators and targeted production.

This course is designed to explain the major function and application of various excavating and transporting equipment used in surface as well as underground mines such as drills, excavators, dumpers, haulages, conveyors, pumps, etc. Their selection procedure and automation to enhance safety and efficiency. After completing this course the student will able to select suitable equipment in varying condition in mines.

2. COMPETENCY

The course should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Select, operate and maintain surface and underground mining machines.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

CO1: Justify the suitability of surface mine machinery as per geo-mining conditions.
CO2: Select suitable underground transport system to match the targeted output.
CO3: Adopt all safety measures to make underground haulage in a safe condition.
CO4: Identify the suitability of mine pump as per the needs of dewatering

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA*	ESE	CA	ESE	
3	-	2	4	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Determine drilling strength of Rock Samples in lab by Rock Drilling Machine.	I	4
2	Determination of productivity and number of shovel by field data and time and motion study.	I	6
3	Determine the productivity of Dumper by field data and time and motion study to get actual number machine required in mine.	I	6
4	Determine number of tubs required to haul a given quantity of material by Direct Rope Haulage System.	III	6
5	Determine the pumping cost for displacement of water up to a certain height.	IV	6
		Total	**28**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*
ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..*

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	• Mine haulage Models • Rope coupling models • Dumper models • Shovel models. • Dozer models. • Rock drill machines. • Jack Hammers.	1-5

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
	• Air compressor for Jack Hammer.	

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site.
d) Practice of environmental friendly methods and processes.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I: Surface Mining Machineries	1a. Describe Application of Surface Machineries for various geo-mining conditions. 1b. Explain constructional & operational features of Surface Mining Machineries. 1c. Explain general safety standards to be followed while using the Surface Mining Machineries.	Applicability Conditions, Constructional Features, Operating Principles, General Safety Measures while using these machines: • Rock Drills • Excavators • Dozers • Dumpers • Draglines • Surface Miner • Reclaimer • Compressor
Unit – II: Underground Transport Machineries	2a. Describe Application of various underground transport machineries for various geo-mining conditions. 2b. Explain constructional and operational features of underground transport machineries. 2c. Explain general safety standards to be followed while using underground transport	2.1 Rope Haulages: Applicability Conditions, Constructional and Operational Features with all operational safety measures taken while using it: • Direct Rope Haulage • Main & Tail Rope Haulage • Endless Rope Haulage • Gravity Rope Haulage 2.2 Locomotive Haulage: Applicability Conditions, Constructional and Operational Features with all operational safety measures taken

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	machineries. 2d. Calculate amount of minerals transported based on load and speed of conveyors.	while using it: • Diesel Locomotive • Battery Locomotive • Trolley Wire Locomotive • Cable Reel Locomotive • Compressed Air Locomotive 2.3 Conveyors: Applicability Conditions, Constructional and Operational Features with all operational safety measures taken while using it 2.3.1 Belt Conveyor: Drive Head, Idler, Tension Arrangement, Troughed Belt 2.3.2 Chain Conveyor: Scraper & Flexible type, Advantages & Disadvantages. 2.3.3 Shaker conveyor: Capacity, Limiting Gradients, Advantages and Disadvantages 2.3.4 Numerical problems.
Unit – III: Mine Track & Safety Devices	3a. Describe Application of Rail Tracks with its standard dimensions. 3b. Explain constructional and operational features of associated railway tracking appliances. 3c. Explain general safety standards to be followed on Mine Tracks.	3.1 Importance, Applicability, Construction Material and Dimension of Mine Tracks/Rail. 3.1.1 Special design features of: • Rail Joints • Sleepers • Ballast • Curves • Crossings • Turnouts. 3.2 Safety devices on Haulage tracks and roadways.
Unit – IV: Dewatering of Mines	4a. Explain sources of water and need of dewatering mines. 4b. Describe Application of various mine pumps with its suitability. 4c. Explain constructional and operational features of mine pumps. 4d. Explain general safety measures to be taken while dewatering the mines.	4.1 Sources of Water in Mines, Purpose of Dewatering 4.2 Applicability Conditions, Constructional and Operational Features with all operational safety measures taken while using it with Advantages and Disadvantages of Mine Pumps: • Ram Pump • Centrifugal Pump • Turbine Pump • Borehole Pump • Sinking Pumps • Mono Pumps

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
1	Surface Mining Machineries	05	2	4	4	10
2	Underground Transport Machineries	16	4	8	8	20
3	Mine Track & Safety Devices	05	3	6	6	15
4	Dewatering of Mines	16	6	9	10	25
Total		**42**	**15**	**27**	**28**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Visit a mining site and collect working data to study the project.
b) Prepare visit report with detail data of particular mine.
c) Undertake micro-project.
d) Make power point presentation on particular visit in group.
e) Give presentation on relevant topic.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken

to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

1. Prepare a chart sheet of various machineries used in mines with their photographs and their details shown in sheet.
2. Prepare presentation lecture on the particular chart sheet.
3. Model: Prepare a model of any one machinery.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Elements of Mining Technology	D. J. Deshmukh	Centre Techno Publication, Nagpur.
2	Mine Pumps and Haulages	S.Ghatak	Lovely Prakashan, Dhanbad
3	UMS Mining Series		Lovely Prakashan, Dhanbad
4	Mine Drainage	Behr & Hans C.	Sacramento

14. SOFTWARE/LEARNING WEBSITES

1. http://www.phmining.com/
2. NPTEL lecture series on Mining Machinery: https://archive.nptel.ac.in/courses/123/105/123105005/
3. http://dhi.nic.in/MINING-CONSTN-EQUIPMENT.pdf
4. http://bemlindia.com/product_mc.php
5. http://en.wikipedia.org/wiki/Heavy_equipment_(construction)
6. http://catalogs.indiamart.com/manufacturers/earth-moving-heavy-equipment.html

15. PO-COMPETENCY-CO MAPPING

Semester III	Mining Machineries-I (Course Code: 4332202)								
	POs and PSOs								
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning	PSO 1 Student will be able to operate flame safety lamp	PSO 2 Student will be able to test percentage of inflammable gas.

								effectively.	
Competency	Select, operate and maintain surface and underground mining machines.								
Course Outcomes **CO1:** Select proper surface as well as underground mining machineries.	3	-	-	-	-	-	2	-	-
CO2: Select proper surface as well as underground transportation machineries.	3	2	-	2	-	-	-	-	-
CO3: Identify the function of various elements used in mine track and safety devices used n haulage track.	3	2	-	3	-	-	-	-	-
CO4: Demonstrate construction features and working of mine dewatering machines.	3	3	-	2	-	-	-	-	-

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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