GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Mining-I
(Course Code: 4332201)

Diploma programme in which this course is offered	Semester in which offered
Mining	Third

1. RATIONALE

The mining engineers are responsible to supervise the drilling and blasting operations in mine. He/She should be able to select the suitable explosives, blasting/ shot firing tools and suitable kind of blasting in mines. This course therefore provides would be mining engineer's basic knowledge of explosives, blasting/ shot firing tools and blasting methods which will make them able to supervise drilling and blasting operations.

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:

- **Plan drilling and blasting operation in mines.**
- **Choose effective blasting practice using proper explosives as per ground condition.**

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: Identify tools and bits of different types of drills with its applicability.
CO2: Enlist different types, properties and constituents of various explosives.
CO3: Explain various types of accessories and exploders with its constructional and safety features.
CO4: Explain the safe blasting practice in mines along with improving blast efficiency.
CO5: Describe the need of controlled blasting techniques with its various methods.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/3+P/0)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA*	ESE	CA	ESE	
3	-	-	3	30	70	00	00	100

(*): 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. 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 mines.
d) Practice of environmentally 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.

6. 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 **Drilling**	1a. Explain drilling and its types with its applications in Mining industry. 1b. Describe applicability and constructional features of various drill bits. 1c. Describe the core recovery methods. 1d. Explain the Problems associated with drilling.	1.1 Explain rock drilling, Purpose of rock drilling, Applications of drilling in mining industry. 1.2 Methods of drilling. 1.2.1 Percussive drilling 1.2.2 Rotary drilling 1.3 Drilling Tools 1.3.1 Drilling chisels 1.3.2 Augers 1.3.3 Types of Drill bits used in mining its constructional features and applicability 1.4 Core recovery- Single tube core barrel and Double tube core barrel 1.5 Problems associated with drilling 1.5.1 Bore hole deviation, factors affecting deviation, remedial measures 1.5.2 Water loss during drilling with remedial measures. 1.5.3 Flushing of bore holes 1.5.4 Removal of broken pieces of drill bits from bore hole - fishing tool.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – II **Explosives**	2a. Classify and describe properties of various explosives with its composition. 2b. Explain permitted and non-permitted explosive with its applicability.	2.1 Definition of explosive 2.2 Properties of explosive 2.3 Classification and differentiation of explosive 2.3.1 Low Explosive 2.3.2 High Explosive 2.4 Composition of Commonly used high explosives 2.4.1 ANFO Explosive 2.4.2 Slurry Explosive 2.4.3 Emulsion Explosive 2.4.4 TNT and LOX 2.5 Permitted Explosive and non-permitted explosive
Unit– III **Blasting Accessories and Magazine**	3a. Describe the use of various accessories used during blasting. 3b. Explain constructional and operational Features of various detonators and exploders. 3c. Explain various types of mine magazine with its constructional and safety features.	3.1 Accessories used during blasting Safety fuse, detonating fuse, nonel, raydet, detonating relays, cord relays, circuit tester, crimper, short firing cables 3.2Types of Detonators 3.2.1 Plain detonators 3.2.2 Electric detonators - Instantaneous detonators - Delay detonators 3.2.3 Advantages of delay detonators 3.3 Types of Exploders 3.3.1 Magneto Exploder 3.3.2 Battery condenser exploder 3.3.3 Dynamo exploder 3.4 Mine Explosive Magazine 3.4.1 Statutory requirements for storage and transportation of explosive 3.4.2 Criteria of selection of place for magazine 3.4.3 Types of magazines Large magazine, Service magazine, Portable magazine

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit- IV **Blasting Practices in Mines**	4a. Define various terminology used for blasting practice in mines. 4b. Explain various procedures and steps fallowed in mines for blasting. 4c. Calculate the blast geometry parameters as per the given conditions. 4d. Explain purpose and types of secondary blasting. 4e. Describe various problems associated with blasting.	4.1 Define Blasting, its purpose and advantages 4.2 Procedure of blasting in Mine 4.2.1 Preparation of charging the hole 4.2.2 Procedure for firing shots 4.2.3 Direct and indirect initiation 4.3 Solid blasting 4.4 Blast geometry - Calculation of blast geometry parameter 4.5 Secondary blasting 4.5.1 Purpose of secondary blasting 4.5.2 Types of secondary blasting Pop shooting, plaster shooting, snake shooting 4.6 Problems associated with blasting 4.6.1 Ground vibration, air blast, fly rock, misfired shot (Dealing with misfired shot) 4.6.2 Common causes of accidents due to blasting
Unit– V **Controlled Blasting**	5a. Explain various techniques and need of controlled blasting.	5.1 Purpose of controlled blasting 5.2 Controlled blasting techniques 5.2.1 Pre-splitting techniques 5.2.2 Muffled blasting 5.2.3 Cushion blasting 5.2.4 Deck blasting

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Drilling	10	07	07	06	20
II	Explosives	08	07	05	00	12
III	Blasting Accessories and Magazine	10	06	07	07	20
IV	Blasting Practices in Mines	08	04	03	05	12
V	Controlled Blasting	06	02	02	02	06
Total		**42**	**26**	**24**	**20**	**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 make a report on blasting practice.
b) Visit a mining site and make a report on magazine.
c) Undertake micro-project.
d) Give presentation on any 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:

a) Prepare a sheet showing blasting pattern with blast geometry.
b) Calculate the powder factor from parameters of mines.
c) Prepare a model showing blast geometry with all parameters.
d) Prepare a sheet showing controlled blasting for reducing environmental nuisance.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Elements of Mining Technology	D. J. Deshmukh	Central techno Publication Latest edition
2	Introduction to Mining	Lewis and Clark	J. Wiley. Latest edition
3	Drilling Technology	Chugh	Oxford and IBH publication, Latest edition
4	Explosive & Blasting Practices in Mines	Dr S.K. Das	Lovely Prakashan, Dhanbad
5	Explosives & Blasting Technique	Dr G. K. Pradhan	Mintech Publications, Bhubaneswar
6	Engineering Rock blasting operation	Sushil Bhandari	A.A. Balkema

14. SOFTWARE/LEARNING WEBSITES

a) https://nptel.ac.in
b) www.gmdcltd.com
c) https://coalindia.in
d) www.miningglobal.com
e) www.youtube.com

15. PO-COMPETENCY-CO MAPPING

Semester III	Mining-I (Course Code:4332201)								
	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 effectively.	PSO 2 Student will be able to test percentage of inflammable gas.
Competency	**i) Plan drilling and blasting operation in mines.** **ii) Choose effective blasting practice using proper explosives as per ground conditions.**								
Course Outcomes **CO1:** Identify tools and bits of different types of drills with its applicability.	2	-	-	2	-	-	2	-	-
CO2: Enlist different types, properties and constituents of various explosives.	2	-	-	-	-	-	2	-	-
CO3: Explain various types of accessories and exploders with its constructional and safety features.	3	2	-	2	-	-	2	-	-
CO4: Explain the safe blasting practice in mines along with improving blast efficiency.	3	2	-	-	2	-	2	-	-
CO5: Describe the need of controlled blasting techniques with its various methods.	2	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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