**GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**

**Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)**
Semester-IV

**Course Title: Mining-II**
(Course Code:4342201)

| Diploma programme in which this course is offered | Semester in which offered |
|---|---|
| Mining Engineering | Fourth |

## 1. RATIONALE

The diploma holders in mining engineering will be responsible to supervise the shaft sinking operations, drift drivage operation & support erection operation in underground mines. Students should be able to select the suitable ground, drilling pattern, explosives & shot firing with its tools in shaft sinking operation & drift drivage for developing access to underground mines &/or connecting two individual/separate mine parts. This subject provides students basic knowledge of shaft sinking, drift drivage & support erection operations, its associated problems & remedies which will make him able to supervise respective operations.

Competencies developed by this course would therefore be useful for students while performing his/her job in the field of Mining Engineering.

## 2. COMPETENCY

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

- **Develop safe and workable mines accesses including shaft sinking, drift drivage & erection of supports at work places.**

## 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:** Explain selection of shaft site with its various sinking methods.
**CO2:** Select the special method for shaft sinking with its applicability conditions.
**CO3:** Explain safe drift drivage operation with its applicability conditions.
**CO4:** Explain properties of various types of roofs with its testing methods and various support system used in mines.

## 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 | - | - | 3 | 70 | 30 | 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 site.
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**<br><br>**Shaft & its Sinking operation** | 1a. Explain types of Shafts with its applicability.<br>1b. Describe necessary conditions considered for shaft sinking operation.<br>1c. Describe various methods and technical parameters used during sinking operation. | 1.1 Types of Shaft- Vertical & Inclined; its applicability<br>1.2 Preliminary Consideration for Shaft Sinking operation: - Site selection, Shape, size.<br>1.3 Shaft Sinking operation:<br>(i) Sinking up to Rock head.<br>(ii) Sinking through strata below Rock Head<br>(iii) Drilling, Blasting& mucking.<br>1.4 Shaft Centering operation.<br>1.5 Temporary Support of shaft sides.<br>1.6 Erection of Permanent lining- Brick walling, Monolithic concrete lining and Cast iron tubing.<br>1.7 Ventilation, Lighting & dealing with water during Shaft sinking. |

| | | |
|---|---|---|
| **Unit- II**<br><br>**Special methods for Shaft sinking** | 2a. Explain various special methods of shaft sinking with its applicability conditions. | 2.1 Requirements of Special methods for shaft sinking.<br>2.2 Types of special methods for shaft sinking<br>2.2.1 Piling system<br>2.2.2 Caisson methods<br>2.2.3 Freezing method<br>2.2.4Cementation process |
| **Unit- III**<br><br>**Drift/ Tunnel & its driving operation** | 3a. Define, compare and explain the methods of drifting & Tunnelling.<br>3b. Describe Ventilation arrangement in short& long drift. | 3.1 Drift & Tunnel- Definitions & advantages of drift over staple shaft.<br>3.2 Drift drivage operation: drilling, blasting, mucking.<br>3.3 Ventilation arrangements in short & long Drift. |
| **Unit- IV**<br><br>**Mine Supports** | 4a. Explain testing procedure of various properties of roofs.<br>4b. Describe various types of supports with its applicability & limitations.<br>4c. Draw a mine support plan. | 4.1 Properties of various types of roofs.<br>4.2 Roof testing methods and analysis.<br>4.3 Materials employed for supports-<br>(i) Timber- Setting props, Timber bars, Safari supports & side supports; Systematic timbering; Withdrawal of supports.<br>(ii) Iron & Steel- advantages over timber; Yielding props, Friction props, Hydraulic props, Friction Vs. Hydraulic props<br>(iii) Roof Bolting and Roof Stitching. – Principle of action, common types, advantages.<br>4.4 Draw a mine support plan for various unsupported areas like goaf, junction, galleries, face etc. |

## 7. 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 | Shaft & Its Sinking operation | 09 | 5 | 7 | 3 | 15 |
| II | Special methods for shaft sinking | 06 | 4 | 4 | 2 | 10 |
| III | Drift/Tunnel & Its driving operation | 13 | 4 | 8 | 8 | 20 |
| IV | Mine Supports | 14 | 5 | 10 | 10 | 25 |
| **Total** | | **42** | **18** | **29** | **23** | **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.*

## 8. 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:

Following is the list of proposed student activities like:

1. Student will visit nearby Underground Mines for understanding various entry of mines and supports used.

## 10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

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) Use demonstration, video/animation films field/industry visit for explaining complex/abstract concepts of Hydraulics.
d) This course requires lot of practice on numerical. Students may be asked to solve the numerical during lecture periods and tutorial periods, in addition home assignments may be given. To avoid copying by students each problem must have different parameters for each student or at least there may be five to six sets of problems with different values., In other words each student will get same problem but with varied parameters. (Values of pressure, volume, flow, force, distance, speed etc. may be different for each student)
e) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
f) 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.
g) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
h) Guide students on how to address issues on environment and sustainability

## 11. 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-projects 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 she/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 schematic diagram sheet showing temporary lining & permanent lining used during shaft sinking operation.**
**B) Prepare a flowsheet of drilling & blasting operation used during shaft sinking (Briefly explain all activities)**
**C) Prepare a chart showing the selective criteria for special methods of shaft sinking. (Briefly explain the methods)**
**D) Design a comparative analysis chart showing the selective criteria for different types of mine access.**

## 12. SUGGESTED LEARNING RESOURCES

| Sr. No. | Title of Book | Author | Publication with place, year and ISBN |
|---|---|---|---|
| 1 | Elements of Mining Technology, Volume-I | D.J. Deshmukh | Denett & Co. |
| 2 | Modern coal Mining Technology | S.K. Das | Lovely Prakashan |
| 3 | Underground Metalliferous Mining Methods | Y.P. Chacharkar | Lovely Prakashan |
| 4 | Universal Mining School | | Lovely Prakashan |

## 12. SOFTWARE/LEARNING WEBSITES (From Old Syllabus)

a) NPTEL Lecture series on Underground Mining of Metalliferous deposits: https://archive.nptel.ac.in/courses/123/105/123105006/
b) You tube link:- https://www.youtube.com/watch?v=Dj_JugL7TDk&t=1908s
c) www.mining-enc.com (Mining Encyclopedia)
d) www.ibm.gov.in
e) www.dgms.gov.in

## 13. PO-COMPETENCY-CO MAPPING

| Semester IV | Mining-II (Course Code: 4342201) 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** | Develop safe and workable mines accesses including shaft sinking, drift drivage & erection of supports at work places. | | | | | | | | |
| **Course Outcome** **CO1:** Explain selection of shaft site with its various sinking methods. | 2 | 3 | 2 | - | - | - | 2 | - | - |
| **CO2:** Select the special method for shaft sinking with its applicability conditions. | 2 | 3 | 2 | - | 2 | - | - | - | - |
| **CO3:** Explain safe drift drivage operation with its applicability conditions. | 2 | - | - | - | - | - | 2 | - | - |
| **CO4:** Explain properties of various types of roofs with its testing methods and various support system used in mines. | 2 | 2 | - | 2 | - | - | 2 | - | - |

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

## 14. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### GTU Resource Persons

| Sr. No. | Name and Designation | Institute | Contact No. | Email |
|---|---|---|---|---|
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