

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: ROCK MECHANICS
(COURSE CODE: 3352203)**

Diploma Programme in which this course is offered	Semester in which offered
Mining Engineering	5 th Semester

1. RATIONALE

The diploma holders in mining engineering will be responsible to supervise the operation of driving various kinds of safe & stable underground opening. They should be able to select the suitable shape & size of opening with suitable drilling pattern, explosives & shot firing with its tools. This subject provides them basic knowledge of stress concentration fields, rock strength, its associated problems & remedies which will make them able to supervise & drive safe & stable underground opening.

2. LIST OF COMPETENCY

The course content should be taught with the aim to develop required skills in the students so that students are able to acquire following competency:

- **Resolve problems related to strata stability for safe underground and surface mining operations using knowledge and skills of rock mechanics.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Explain stresses in strata involved in mining operations.
- Explain principles of rock mechanics for effective strata stability.
- Elaborate principle of exploration and feasibility of mining.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	70	30	20	30	150

Legends: **L** - Lecture; **T** -Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** -End Semester Examination; **PA** - Progressive Assessment

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
Unit – I Rock Mechanics:	1a: Define Rock mechanics & explain its importance. 1b: Explain mass & material form of rock with effects of discontinuities on its strength. 1c: Explain stresses involved in mining. 1d: Explain engineering Classification of rock masses (by deer & miller).	1.1 Definition & its importance. 1.2 Rock mass & material form; Effects of discontinuities on rock mass. 1.3 (a) Physical properties of rocks- - Porosity - Density - Moisture content - Degree of saturation - Coefficient of permeability - Electrical properties - Thermal properties - Swelling - Anisotropy - Durability (b) Mechanical properties of rocks- - Strength (Compressive, Tensile & Shear) - Deformability - Elasticity & Plasticity - Hardness 1.4 Stresses involved in mining. 1.5 Engineering Classification of rock Masses (by deer & miller). 1.6 Moh's scale of Hardness.
Unit – II Rock Pressure & Subsidence:	2a. Explain Pressure arch theory on different openings. 2b. Explain Creep, Convergence, Rock burst & Coal bumps. 2c: Describe the governing factors & protective measures against subsidence.	2.1 Pressure arch theory- Rectangular opening, circular shaft & long wall working. 2.2 Creep, Convergence, Rock burst & Coal bumps, Rock Mass Rating. 2.3 Subsidence: Definition & factors governing subsidence. 2.4 Angle of draw, line of break; Critical area, Sub-critical area, Super critical area. 2.5 Protective measures against Subsidence.

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
Unit – III Rock Testing:	3a. Describe procedure for collecting of samples, its preparation as specimen. 3b. Explain different tests for measuring rock strengths.	3.1 Introduction 3.2 Sampling and Sample preparation 3.3 Specimen 3.3 Uni-axial compressive strength Test; Protodykanov strength index. Tests for measuring rock strengths 3.5 Tensile strength tests (i) Brazilian tests (ii) Bending tests 3.6 Flexural strength test- Three point & Four point load test 3.7 Shear strength test- (a) Direct Shear strength test (i) Shear box test (ii) Direct shear test on rock cubes (b) Indirect Shear strength test- Punch shear test. 3.8 In situ tests: (i) Flat jack & load cells for load measurement. (ii) Extensometer & roof sag meter for deformation measurement. (iii) Flat jack for stress measurement. (iv) Strain guage for measuring strain.
Unit – IV Rock Exploration:	4a. Explain objectives & methods of rock exploration.	4.1 Introduction 4.2 Object of exploration 4.3 Methods of rock exploration 4.4 Rock exploration- (a) by direct penetration - Core boring - Core recovery - Rock quality designation - Fracture frequency (b) by indirect penetration - Large diameter calyx hole - Logging of core

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Rock Mechanics	12	4	8	8	20
2	Rock pressure & Subsidence	12	4	8	8	20
3	Rock testing	12	4	8	8	20
4	Rock Exploration.	06	2	4	4	10
Total		42	14	28	28	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's Revised Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (*outcomes in psychomotor and affective domain*) so that students are able to acquire the competencies/course outcomes. Following is the list of practical exercises for guidance.

Note: outcomes in psychomotor domain are listed here as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of Course Outcomes related to affective domain. Thus over all development of Programme Outcomes (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty members should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise (outcomes in psychomotor domain)	Apprx. Hrs. Required
1	1	Design temporary lining during shaft sinking.	4
2	1	Design permanent lining during shaft sinking.	4
3	1	Design various drilling & blasting pattern for shaft sinking with its purpose.	4
4	1	Prepare models of different types of special methods of shaft sinking.	4
5	2	Design different types of blast hole patterns in drift drivage/tunnelling with its purpose.	4
6	3	Perform erection & withdrawal of Timber, Hydraulic & friction props.	4
7	3	Design different ways of supporting road way & roadway junctions.	4
Total			28

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Seminar Presentation based on study of different topics by exploring internet.
- ii. Group discussion.

9. Special Instructional Strategies (if any):

- i. Ask students to visit nearby mines and study different rock testing and rock exploration procedures and prepare a report on it.
- ii. Show pictures/films on rock testing and rock exploration procedures.

10. SUGGESTED LEARNING RESOURCES**(A) List of Books:**

S. No.	Title of Books	Author	Publication
1	Elements of Mining Technology - I	D. J. Deshmukh	Central techno publication
2	Modern Coal Mining Technology	S.K.Das	Lovely Prakashan
3	Rock Mechanics for Engineers	B.P.Verma	Khanna Publishers

B. List of Major Equipment/Materials:

- i. Models.
- ii. Chart

C List of Software/Learning Websites

- i. Wikipedia.
- ii. www.youtube.com

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. S.G. Srivastav**, (I/c HOD) Lecturer, G.P.Bhuj
- **Prof. P.Y Trivedi**, Lecturer, G.P.Bhuj

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. Dr. K .K Pathak**, Prof. Dept. of Civil & Environment Engineering
- **Prof. Peeyush Verma** , Professor, Department of Vocational Education & Entrepreneurship Development