# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Diploma Engineering**

**Level: Diploma**

**Branch: Mining Engineering**

**Subject Code: DI04022081**

**Subject Name: Rock Mechanics**

| | |
|---|---|
| **w. e. f. Academic Year:** | 2025-26 |
| **Semester:** | 4th |
| **Category of the Course:** | Professional Elective - II |

| | |
|---|---|
| **Prerequisite:** | Basic knowledge of geology and types of rocks, Elementary physics and mechanics (stress, strain, force), Basic mining operations |
| **Rationale:** | Rock Mechanics is a fundamental subject for mining engineers as it provides an understanding of the behavior of rocks under different stress conditions. Knowledge of rock properties, strength, and failure mechanisms is essential for designing safe and efficient mining operations such as excavation, drilling, blasting, and ground support.<br>This subject helps students understand the stability of mine workings, subsidence, and suitable support systems to prevent hazards. It bridges theoretical knowledge with practical applications, preparing students for modern mining practices and safety management. |

**Course Outcome:**

After Completion of the Course, Student will able to:

| No. | Course Outcomes | RBT Level |
|---|---|---|
| 01 | Explain importance of rock mechanics and rock exploration methods. | R |
| 02 | Describe physical and mechanical properties of rocks. | R, U |
| 03 | Understand various rock strength testing procedure. | R, U, A |
| 04 | Explain rock pressure, failure, and subsidence control. | R, U |
| 05 | Understand rock mass classification and their supports. | R, U |

**Revised Bloom's Taxonomy (RBT)*

**Teaching and Examination Scheme:**

| Teaching Scheme (in Hours) | | | Total Credits L+T+ (PR/2) | Assessment Pattern and Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | Tutorial / Practical | | |
| L | T | PR | C | ESE (E) | PA (M) | PA (I) | ESE (V) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 20 | 30 | 150 |

**Course Content:**

| Unit No. | Content | No. of Hours | % of Weightage |
|---|---|---|---|
| 1. | **Introduction and Rock Exploration**<br>1.1 Rock Mechanics: Definition and its importance in mining<br>1.2 Rock Mass and Rock Material<br>1.3 Rock exploration by direct penetration:<br>1.3.1 Core boring<br>1.3.2 Core recovery<br>1.3.3 Rock Quality Designation (RQD)<br>1.3.4 Logging of cores | 06 | 13 |
| 2. | **Rock Properties:**<br>2.1 Physical properties of rock:<br>Porosity, Density, Moisture content, Coefficient of permeability, Electrical properties, Thermal properties, Swelling, Anisotropy, Durability, & Degree of saturation.<br>2.2 Mechanical properties of rock:<br>Strength: Compressive strength, Tensile strength, & Shear strength;<br>Elasticity, Plasticity, Deformability, Poisson's ratio & Hardness with its Mohr's scale. | 06 | 13 |
| 3. | **Rock Testing:**<br>3.1 Sampling and sample preparation<br>3.2 Specimen<br>3.3 Compressive strength test:<br>3.3.1 Uniaxial compressive strength test<br>3.3.2 Impact strength Index test<br>3.3.3 Protodyakonov strength Index test<br>3.4 Tensile strength test:<br>3.4.1 Brazilian test<br>3.4.2 Flexural strength test:<br>3.4.2.1 Three-point load test<br>3.4.2.2 Four-point load test<br>3.5 Shear strength test:<br>3.5.1 Shear box test<br>3.5.2 Direct shear test on rock cube | 16 | 36 |

| | | | |
|---|---|---|---|
| | 3.5.3 Punch shear test<br>3.6 Rock Durability test<br>3.7 In situ Measurements:<br>3.7.1 Measurement of Load: Flat Jack and Load cell<br>3.7.2 Roof sag measurement by extensometer<br>3.7.3 Stress measurement by Flat Jack | | |
| 4. | **Rock pressure and its failure:**<br>4.1 Stresses involved in Mining<br>4.2 Pressure Arch Theory<br>4.3 Creep<br>4.4 Convergence<br>4.5 Rock burst<br>4.6 Coal bumps and Its drilling yield test<br>4.7 Subsidence:<br>4.7.1 Introduction<br>4.7.2 Definition: Subsidence factor, Angle of Draw, Critical area, Sub-critical area, Super-critical area<br>4.7.3 Factors governing subsidence<br>4.7.4 Protective measures against subsidence | 11 | 25 |
| 5. | **Rock Mass Classification:**<br>5.1 Objectives<br>5.2 Engineering Classification of Intact rock by Deere and Miller<br>5.3 Geomechanics classification or Rock Mass Rating (RMR) System<br>5.4 Requirement of support based on RMR<br>5.5 Q System | 06 | 13 |
| | **Total** | **45** | **100** |

**Suggested Specification Table with Marks (Theory):**

| **Distribution of Theory Marks (in %)** | | | | | |
|---|---|---|---|---|---|
| **R Level** | **U Level** | **A Level** | **N Level** | **E Level** | **C Level** |
| **20** | **70** | **10** | **0** | **0** | **0** |

*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:**

| Sr. No. | Title of Book | Author | Publication with place, year, and ISBN |
|---|---|---|---|
| 1 | Rock Mechanics for Engineers | Dr. B. P. Verma | Khanna Publishers, Delhi<br>ISBN: 9789387394155 |
| 2 | Modern Coal Mining Technology | S. K. Das | Lovely Prakashan, Dhanbad |

**(b) Open-source software and website:**

1. Rock Mechanics and Tunnelling: NPTEL Course by IIT Kharagpur:
   https://nptel.ac.in/courses/105105212
2. Sample Preparation:
   Part 1: https://www.youtube.com/watch?v=lqF3PhFcbbI
   Part 2: https://www.youtube.com/watch?v=mPs_6v5H5Cg
   Part 3: https://www.youtube.com/watch?v=dc7Cx1ublU4
   Part 4: https://www.youtube.com/watch?v=IUQfluSVguA
   Part 5: https://www.youtube.com/watch?v=CrKUEUfS9mA
3. Slake Durability Index of Rock:
   https://www.youtube.com/watch?v=zMIZ1-3avu0
4. Uniaxial Compressive Strength:
   Part 1: https://www.youtube.com/watch?v=kIm97vmVjiw
   Part 2: https://www.youtube.com/watch?v=kUcpRSCV4zY
5. Protodykonov Strength Index:
   https://www.youtube.com/watch?v=Jgpp1vemff0
6. Tensile strength Test (By Brazilian test):
   Part 1: https://www.youtube.com/watch?v=pEGBGZ0rYMM
   Part 2: https://www.youtube.com/watch?v=pvpoczG0CF0
   Part 3: https://www.youtube.com/watch?v=wM1GXoPEdxE
7. Shear strength Test (By Shear box):
   https://www.youtube.com/watch?v=LrSkl_GRA3g
8. Point load strength index:
   Part 1: https://www.youtube.com/watch?v=3rFi4DkSypk
   Part 2: https://www.youtube.com/shorts/hFvwQr1iXYs

**Suggested Course Practical List:**

| Sr. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---|---|---|---|
| 1 | Determine the quality of rock by RQD test procedure from the cores collected from the bore holes. | 1 | 02 |
| 2 | Prepare a cylindrical specimen sample for strength testing purpose by cutting, grinding, and polishing. | 3 | 06 |
| 3 | Determine the uniaxial compressive strength of a given specimen. | 3 | 04 |
| 4 | Determine the Impact Strength Index of given sample. | 3 | 04 |
| 5 | Determine the tensile strength of a rock by Brazilian test. | 3 | 06 |
| 6 | Measure durability of rock samples by durability test. | 3 | 06 |
| 7 | Calculate the RMR based on the given deposit data. | 5 | 02 |
| | | | **30 Hrs.** |

**Suggested Project List:**

1. Prepare a chart showing classification of rock mass based on RMR.
2. Prepare a schematic diagram showing elementary features of subsidence due to mine openings.
3. Prepare a chart on Mohr's scale of hardness for various rocks.

**Suggested Activities for Students:**

1. Conduct a group discussion on various issues of rock strength affecting parameters.
2. Visit nearby mine a make a report on rock testing, techniques adopted by them.

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