

Course Name : Three years Diploma in Mining Engineering
Year : Second
Subject Title : **ROCK ENGINEERING and GROUND CONTROL**
Subject Code : **M205**

Teaching and Examination Scheme:

| Teaching Scheme* | | | Examination Scheme | | | | | |
|-----------------------|---|---|--------------------|---------------------|---------------------|--------------------|------------------|----------------------------|
| L | T | P | Full Marks | External Exam Marks | Internal Exam Marks | External Pas Marks | Total Pass Marks | Duration of External Exams |
| 2 | 1 | 0 | 100 | 80 | 20 | 26 | 40 | 3 Hrs. |
| Practical (MI 211) | | 2 | 100 | 80 | 20 | 26 | 40 | 4 Hrs. |

*Duration of year is considered 28 weeks

The Diploma holder in Mining and Mine surveying must have knowledge of Rock engineering as the underground opening are subject to accumulation of stress which make opening unstable, therefore he must understand the kind of support required to stabilize the opening. He also required to work as technical asst. in various Technical and Research Institutes, therefore he must have knowledge of different properties of rock and procedure of determining the properties of rock in laboratory and insides the mine. The mining engineer should have knowledge of Rock burst, bumps, precautions measure and methods of prediction etc.

COURSE OUTCOMES:

After undergoing the course of study the student shall be able to

1. Classify to rock mass.
2. Identify the kind of support required to the excavation.
3. Conduct different laboratory test to determine properties of rock.
4. Carryout monitoring, predict and supervise and carryout preventive measures for rock burst, bumps etc.
5. Carryout and supervise roof bolting and stitching operation.

| Unit | Content | Contact Hours | Marks |
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| Group A | | | |
| 1. | ORIGIN of SOIL & ITS FORMATION Weathering, Post Depositional changes, Sediment erosion, Transport and Deposition, Rock and | | |

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| | Mineral Stability. | | |
| 2. | SOIL as THREE PHASE SYSTEM Weight and Volume relationship, Inter relationship between three phase elements, Density and unit weight relationship | | |
| 3. | PERMEABILITY and SEEPAGE Darcy's Law, Effective Permeability, Laboratory determination of permeability (Falling and Constant Head), Seepage force and different heads, Quick Sand condition | | |
| 4. | SHEAR STRENGTH of EARTH PRESSURE THEORIES Columb's Law of shear strength, Direct and tri axial shear test, Rankine's theory of earth pressure, Active, passive and earth pressure at rest, Simple application on Cohesionless backfills. | | |
| 5. | STABILITY of SLOPES Finite and infinite Slopes, Factor of safety and slip surfaces, Method of slices for c- ϕ soil, Friction circle method, Taylor's and Bishop method, Stability number, Application to open cast mining. | | |
| Group B | | | |
| 1. | INTRODUCTION TO ROCK MECHANICS 1.1 Concept of stress and strain in rock, stress due to weight of strata, vertical lateral stresses. 1.2 Stress due to tectonic and orogenic force, Residual stresses, Induced stresses. 1.3 Field stresses 1.4 Introduction to elementary rock mass classification based on strength, hardness, RQD, Bieniawski RMR classification. | | |
| 2. | ROCK MASS PROPERTIES 2.1. Strength Properties: Compressive strength, Tensile Strength, Shear Strength, Flexural Strength. 2.2. Strength Indices- Point Load Strength index, Impact Strength index, Protodykonov strength index. Rebound hardness, insitu stress by flat jack 2.3. Material Characteristics: Brittle material, Ductile material, Elastic material, Plastic material. 2.4. Time dependent properties: creep, Creep curve, factors contributing Creep. Deformation, weatherability. | | |

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| 3. | ROCK TESTING 3.1. Uniaxial compressive strength, Tensile strength – Brazilian test, Bending test. Shear strength test- punch shear test, Direct shear test on Rock cube, Triaxial method. 3.2. Determination of strength indices- point load strength index, Protodykonov strength index, impact strength index. | | |
| 4. | ROCK BRUST AND BUMPS 4.1. Rock burst, Bumps, causes controlling measures, factors affecting proneness to rock burst/Bumps. 4.2. Pillar Design- factors considered. Pillar design by tributary area approach, determination of factor of safety. | | |
| Group C | | | |
| 5. | MONITORING GROUND MOVEMENT 5.1. Classification of field instrumentation for ground control and rock mechanics studies. 5.2. Closure meters: Telescopic closure meter, Tape closure meter/ extensometer, and Remote indicating closure meter. 5.3. Borehole Extensometer: Rod type; Magnetic type. 5.4. Stress Meter, Bolt meter, Rock Bolt Pull Out Tester, Load Cell.Their application, working principle Construction etc. | | |
| 6. | GROUND CONTROL 6.1. Theories of mechanics of strata behavior: Dome or arch theory, Beam theory. 6.2. Function of roof bolts. Principle of Action Roof Bolts. 6.3. Varieties of Roof Bolts: Slot and Wedge, Expansion shell Grouted Roof Bolts, Resin Roof Bolts. 6.4. Anchorage Testing of Roof Bolts. 6.5. Bolt density. 6.6. Code of practice for roof bolting in underground mines. 6.7. Roof stitching, Principle of Roof stitching, Cable Bolting. | | |

PRACTICAL:

1. Sand bottle method of field density and void ratio
2. Determination of Plastic Limit, Liquid Limit and Shrinkage Limit

3. Falling head permeameter for permeability
4. Direct shear test for soil
5. Preparation of rock sample for laboratory testing.
6. Determination of uniaxial compressive strength of a rock sample.
7. Determination of tensile strength (Brazilian test) of a rock sample.
8. Determination of shear strength. of a rock sample.
9. Determination of point load strength index.
10. Determination of Protodykonov strength index.
11. Determination of impact strength index.
12. Demonstration of use of flat jack for in-situ stress determination.
13. Demonstration of Closure Meters, Extensometer, Stress cells and Load Cells
14. Demonstration of various Rock bolts.
15. Study of anchorage testing of rock bolts.
16. Demonstration of cable bolting.

STRATEGY OF IMPLEMENTATION:

Conducting theory classes, practical, Industrial visits seminars group discussion, and assignment on different topics shall complete the curriculum for the subject.

REFERENCE BOOKS:

| Author | Title | Publisher |
|----------------|--|------------------------------------|
| D.J. Deshmukh | Elements of Mining Technology Vol I | Central techno publication, Nagpur |
| S.K. Das | Modern Coal mining Technology | Mintech publication Bhubaneshwar. |
| B.S. Verma | The elements of mechanics of mining ground | Tuhin& Co. Lucknow |
| Dr. B.P. Verma | Rock Mechanics for Engineers. | Khanna Publication Delhi. |