



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

SubjectCode: 3142209

Semester– IV

SubjectName: ROCK MECHANICS

Type of course: Regular

Prerequisite: Zeal to learn the subject and Mechanics of Solids

Rationale: A good knowledge of rock properties and behavior is essential in planning and designing of rock various rock excavation projects. Knowledge of rock mechanics in mining can solve the associated problems in the field and to do prediction modeling.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total(Hrs)	Weightage (%)
1	Definition, Applications of Rock Mechanics in mining areas.	04	06
2	Stress and Strain in Rock: Analysis of stress, strain and constitutive relations in isotropic and anisotropic rock and	06	10
3	Physico-mechanical Properties of Rock: Determination of physical properties, Strengths, Strength indices and static elastic constants, Parameters influencing strength, Abrasivity and its determination, Specific gravity,	08	14
4	Dynamic Properties of Rock and Rock mass	04	10
5	Time Dependent Properties of Rock: Creep deformation and strength behaviour, Creep test and rheological models.	06	10
6	Behaviour of Rock mass: Rock mass structure, Classification in-situ elastic properties and strength determination.	06	10
7	Failure Criteria for Rock and Rock mass: Mechanics of rock failure, Coulomb, Mohr and Griffith criteria, Empirical criteria.	06	10
8	Pre-mining State of Stress: Sources, Methods of determination including overcoring and hydro-fracturing methods.	06	10
9	Rock Mass Classification: Introduction. Development of classification methods through Rock Quality Designation Index (RQD). Rock Structure Rating (RSR) system by Wickham. Significance of RSR system. Rock Mass Rating (RMR) by Bieniawski. Parameters used to classify rock mass using RMR system. Modified RMR for mining. Tunnelling Quality Index (Q). Comparison of RMR and Q. Application of Rock Mass Classification in solving mining problems.	08	10



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10	Underground Supports: Redistribution of rock pressure on conventional and Powered supporting, Theory of reinforcement of rock mass by Rock Bolting, Cable Bolting, Roof Trusses, Shotcreting etc. Mechanism of support by cable bolting. Forces and displacements associated with cable bolting. Roof testing and stitching.	06	10
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	10	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's 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.

Reference Books:

1. Rock Mechanics, B. P. Verma
2. Elements of Mining Technology, Volume-I, D. J. Deshmukh
3. Rock Mechanics and design of Structure in Rock, Leonard Obert and Wilbur I. Duvall
4. Handbook on Mechanical Properties of Rocks, R. D. Lama and V.S. Vutukuri
5. The elements of Mechanics of Mining Ground (Vol I & II), Dr. B. S. Verma
6. Ground Control in Mining, S. K. Sarkar
7. Introduction to Rock Mechanics, R. E. Goodman.
8. Finite Element Method: Concepts and Applications in Geomechanics, Debasis Deb
9. Fundamentals and Applications of Rock Mechanics, A. K. Verma and Debasis Deb
10. Principles and practices of Modern Coal Mining by R. D. Singh

Course Outcome:

After learning the course the students should be able to:

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:

1. Carry out various physico-mechanical tests.
2. Understand the rock behavior.
3. Analyze of available data for Rock Engineering.



4. Solve rock mechanics problem in mining and excavation projects.

ListofExperiments:

1. Preparation of rock samples for laboratory tests as per ISRM standards.
2. Determination of RQD and core recovery factor for borehole logs.
3. Determination of density, porosity and void ratio for a given rock sample.
4. Determination of UCS, Young's Modulus and Poisson's ratio of prepared rock samples.
5. Determination of tensile strength of the samples by brazilian test.
6. Determination of UCS by Schmidt hammer: Non-destructive test (NDT).
7. Determination of slake durability index of given rock samples.
8. Determination of Protodykonov strength index of a rock samples.
9. Determination of point load strength index of given rock samples.
10. Determination of shear strength of given rock samples.

DesignbasedProblems(DP)/OpenEndedProblem:

Visittoan undergroundminesandstudy&observethevarioustypesofopeninginmines, stressconcentration and distribution at mineopenings andexcavated areas, Redistribution of rock pressure via various support systems.

MajorEquipments:

1. Core cutting machine
2. Diamond saw rock cutter
3. Rock polishing machine
4. Data acquisition system for strain measurement
5. 150 Tone Compression testing machine
6. Liquid limit device
7. Muffle furnace
8. Clinometer compass
9. Permeability test setup
10. Slake durability test apparatus
11. Schmidt hammer test apparatus
12. Protodyakonov apparatus
13. Point load apparatus
14. Ultrasonic tester
15. Vibrator machine
16. Infrared surface temperature measurement apparatus
17. Minimate with microphone
18. Direct shear test apparatus
19. Brazilian cage for tensile strength test
20. Punch shear strength test machine
21. Compressed air pressure system
22. Sieve analyser



List of Open Source Software/learning website:

1. <https://www.rocscience.com/>
2. <https://www.rockware.com/>
3. <https://www.plaxis.com/>
4. <https://www.ansys.com/>
5. <https://www.geostru.eu/>
6. <http://www.dataminesoftware.com/>
7. <http://www.tunnelassistant.gr/>
8. <https://www.autodesk.in/solutions/finite-element-analysis>
9. <https://www.pasisrl.it/>
10. <https://geomechanica.com/>
11. <https://nptel.ac.in/>