GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)
Subject Code: 2960605
6th Semester
Rock Mechanics & Tunneling

Type of course: Elective

Prerequisite: Geotechnical Engineering, Mechanics of Solids and Fluid Mechanics

Rationale: The course on *Rock Mechanics & Tunneling* provides the students basic knowledge on rock exploration, classification, mechanical properties of rock, rock testing, tunnel classification, its purposes, constructions supported with rock bolting, rock anchoring, rock stability and its engineering applications acquainted with latest field practices and codal provisions. This will help them to identify rock type, classify rock mass, rock parameters based on testing, in-situ stress determination for rock strength, tunnel selection, tunnel design and its construction implications for underground structures and mining applications for various types of infrastructural projects/need.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	ESE (V)	PA(I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Module I: Rock formation, exploration and classification:** Basic terminology, Its genesis, Rock and Rock mass classification, Geological petro graphic, Index properties of rocks, Physical and Mechanical properties, Defects in rock mass, Elastic constants of rock; Insitu stresses in rock, Modes of failures of rocks, Objective of **r**ock exploration, methods of rock exploration; by direct penetration, by geophysical processing, in-situ and laboratory tests. Examples	10
2	**Module II: Rock strength and failure** Rock strength, Types of failure, Theories of failure (Coulomb-Navier, Mohr, Griffith), Hoek and Brown Strength criteria for rocks with discontinuity sets, Absolute stress by bore hole deformation method, Flat jack method, Propagation velocity method, Bearing capacity of foundations on rocks – case studies; Examples Testing of rocks: Laboratory and field test, assessment of in-situ strength	06
3	**Module III: Rock Bearing Capacity and Rock Stability** Rock Foundation: Shallow and Deep investigation for foundation design and construction aspect, Slope Stability analysis, Mode of failures in rock. Design of slopes, Excavation in rock and stabilization concepts, Bearing capacity of foundations on rocks – case studies, Examples	06
3	**Module IV: Tunnels** Tunnels – Basic terminology and application, Site investigations, methods of excavation	06

	of tunnels, supports and stabilization, Construction control and maintenance, tunnel ventilation, control of ground water and gas.	
4	**Module V: Design of Tunnels and Construction** General Principles; Tunneling in solid rocks; Full face tunneling without supports and with supports, Single stage mining methods and multi-stage classical methods of tunnel construction, shield tunneling Analysis and Design of horse-shoe shaped tunnels, Design of circular shape tunnels.	10
5	**Module VI: Engineering Applications** Reinforcement of fractured and jointed rocks - Shotcreting, Bolting, Anchoring, Installation methods - Case studies. Rock bolting, Reinforcement of laminated rock	04

Reference Books:

1. K.Szechy "Art of Tunnelling" Publised by – "Atademiaikiado , Budapest 1973"
2. Obert & Duall- "Rock Mechanics & Design of Structures in Rock"
3. Jager & Cook " Fundamentals of Rock Mechanics"
4. Verma B.P."Rock Mechanics Engineers", Khanna Publishers. New Delhi 1985
5. Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamon publications, 1997.
6. Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springerverlag, Berlin, 1990.
7. T. Ramamurthy, Editor, Engineering in Rocks for Slopes Foundations and Tunnels, PHI Learning Pvt. Ltd., 2007

Course Outcomes: Students will be able to

Sr. No.	CO statement Students will be able to:	Marks % weightage
CO-1	Classify Rock system with complete testing program and calculate bearing capacity of Rocks.	25
CO-2	Check stability of Rock under different stress conditions	20
CO-3	Design for rock reinforcement by means of rock bolting, rock is grouting and rock freezing.	20
CO-4	Select and Design tunnels under different circumstances	25
CO-5	Define a role of geotechnical engineer as rock specialist/mining engineer/ tunnel specialist for proper execution of any infrastructure project.	10

List of Experiments/Tutorials

Identification of rock

Point load index – Brazilian test

Direct shear test for Rock

Uniaxial compressive strength test for Rock

Rock Triaxial Shear Test

Slake durability test

Design based Problems (DP)/Open Ended Problem:

Apart from above tutorials/experiments a group of students has to undertake one open ended problem/design problem. Few examples of the same are given below:
1. Development of spread sheets/computer programs for the determination of various index and engineering properties of rock.
2. Determination of rock parameters based on stress-strain relationships and various rock failure criteria.
3. Design of tunnels as per shape and multiple openings or simulation of stresses using either photo-elastic models or using software like PLAXIS, ANSYS

List of Open Source Software/learning website:

1. NPTEL lecture series
2. MIT open source material