GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172218
Semester – VII
Subject Name: Underground Space Technology

Type of course: Open Elective course

Prerequisite: Nil

Rationale: The course is designed to help the student in understanding the different scope and need of underground spaces, their applicability conditions, merits and demerits, various excavation and transport system, ventilation requirements etc. This course is helpful to select suitable and economical method of creating a suitable underground space for a specific purpose.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs
1	Need for underground space Storage of materials, defense facilities including civil defense shelters. Nuclear waste Disposal.	**3**
2	Geo- engineering Investigations: Preparing sub-surface geological x- section, geo-radar use and data analysis for shallow tunnels. Physio-mechanical properties and collection of rock mechanical data.	**4**
3	Planning & Design: Determination of appropriate size and shape. Design of opening in rocks with the help of filed data, instrumentation and monitoring, Numerical modeling to assess the stability.	**4**
4	Underground Storage: Storage for petroleum, storage technique, ground water requirements, water curtain system, types of storage, advantages and disadvantages, global information about oil storage, selected case histories.	**5**
5	Large Caverns: Dimensioning of the cavern, study of in situ state of stress and stability of side walls, Effect of situ stress in deciding the axis of cavern. Excavation for shallow and deep tunnels and caverns.	**6**
6	Shield tunneling, earth pressure balancing shields, types of shields and selection. Excavation sequence for large cavern, machines for excavation and muck transport, blast design and blasting technique. Support design and stabilization techniques: Design of steel supports.	**6**
7	Environmental Aspects: Analysis of exhaust fumes, standards for ventilation in traffic tunnels and other underground facilities, Design of ventilation system.	**4**

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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
10	**20**	**30**	**10**	**20**	**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. Underground space design: A guide to subsurface utilization John Carmody, Raymond sterling
2. Bickel, J.O., Kuesel, T.R., and King, E.H., 1996, Tunnel Engineering Handbook (Second Edition), Chapman & Hall
3. Bieniawski, Z. T., 1992, Design Methodology in Rock Engineering, A.A. Balkema, 196 pages. Hartman: SME Mining Engineering Handbook
4. Whittaker, B. N. and Frith, R. C. (1990): Tunneling: Design, Stability and Construction, London: Institution of Mining and Metallurgy
5. Hoek, E and Brown, E.T. (1980): Underground Excavation in Rock, the Institution of Mining and Metallurgy, London
6. Mahtab, M.A., and Grasso, P., 1992, Geomechanics Principles in the Design of Tunnels and Caverns in Rocks, Elsevier Press
7. Rock Mechanics and Design in Mining and Tunneling Bieniawski, Z.T. Rotterdam A.A. Balkema, 1984

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Analyze the general need and special purpose of utilizing underground space to fulfill various objective of storage of materials.	20
CO-2	Select suitable method and place in underground to create a space, depending upon various techno economic conditions.	30
CO-3	Determination of appropriate size and shape of underground opening in rock mass with proper modelling.	30
CO-4	Analyze all the Environmental Aspects of various gases found in underground and maintain proper ventilation system.	20