GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172215
Semester – VII
Subject Name: Rock Slope Engineering

Type of course: Undergraduate

Prerequisite: Zeal to learn the subject

Rationale: The course is designed to help the student in understanding the influence of various geological, hydrogeological parameters that effect slope stability. This course is also helpful in understanding the mechanics and analysis of slope failures. Also helpful to understand the techniques for analysis and design of pit slopes and waste dumps and remedial measures for stabilizing slopes.

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	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Rock Slope:** Principles of rock slope engineering; Parameters related to slope stability; Slope stability problems in opencast mines; Consequences of slope failures. **Factors Affecting Slope Stability:** Geological factors, Effect of slope geometry, Effect of Ground Water on Rock Slopes, equipment loading, dynamic loading, any other external loading and time.	**12**
2	**Modes and Type of Slope Failure:** Mechanics of slope failure – plane, wedge, circular, toppling, buckling, block and key block failures. Examples of pit slope and dump slope failures. Type of Slope failure (Plain, Circular, Wedge, and Toppling)	**8**
3	**Analysis and Design of Pit Slopes and Waste Dumps:** Analytical, deterministic, probabilistic approaches and numerical analysis of rock and soil slopes; Slope analysis and factor of safety using limit equilibrium methods; Application of RMR/RSR/SMR classification in slope stability evaluation; Sensitivity analysis, Load and Resistance Factor, Stereographic analysis of structural discontinuities, determination of possibility and type of failure based on structural analysis.	**10**
4	**Remedial measures for Stabilizing Slopes:** Stabilisation and strengthening of slopes - Slope geometry configuration; wall control blasting techniques; Slope drainage systems and practices; rock reinforcement.	**8**

5	**Field Instrumentation and Monitoring:** Instrumentations for monitoring slope movements. Surface monitoring methods; Crack width monitor; Global positioning system; Sub-surface monitoring methods- Time–domain reflectometry; Time–movement and time–velocity plots.	**8**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
12	**15**	**15**	**10**	**10**	**8**

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. E. Hoek and J. W. Bray; Rock Slope Engineering; Institute of Mining and Metallurgy.
2. M. G. Anderson and K. S. Richards (Eds); Slope stability—geotechnical engineering and geomorphology; Wiley, Chichester.
3. C. O. Brawner, and V. Milligan; Stability in Open Pit Mining; SME.
4. C. O. Brawner; Stability in Surface Mining; SME.
5. S. D. Priest; Hemispherical Projection Methods in Rock Mechanics; George Allen and Unwin.
6. D. F.Coates; Pit Slope Manual; CANMET.

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply basic principles of rock slope engineering for design and analyse rock slopes for safe and economic operations.	25
CO-2	Identify the modes of failure - plane, wedge, circular and toppling failures.	20
CO-3	Design and analyse the slope considering the geological, hydrogeological	25

	factors and design parameters.	
CO-4	Suggest and implement remedial measures for stabilizing slopes, wherever necessary.	15
CO-5	Plan field instrumentation and monitoring of open pit and dump slopes.	15

List of Experiments:
Following experiments are suggested for Laboratory work

Sr. No	Practical /Exercise	Approx. Hours Required
1	Derivation of expression for determination of factor of safety for Plane Slope failure under following conditions. (i) Joint only. (ii) A tensile crack in dry condition. (iii) A tensile crack in presence of water pressure. (iv) Using bolts.	8
2	Preparation of a case study of a Slope failure in O/C mines.	4
3	Determination of factor of safety for Plane failure and preparation of a report based on Rock plane Software.	6
4	Determination of factor of safety for Circular failure and preparation of a report based on Slide Software.	6
5	Study of different Slope stabilization techniques.	4
Total		28

Important Note:

80 % From above suggested laboratory work should be covered and remaining 20 % is as per facility available at Department

Design based Problems (DP)/Open Ended Problem:

Visit to a mines and study the bench geometry and mode of slope failure.

Major Equipment:

i. Various mining models related to slope failure.
ii. Various charts of Bench Geometry.
iii. Rock plane Software.

List of Open Source Software/learning website:

i. www.researchgate.net
ii. www.min.eng.com
iii. www.journal.elsevier.com
iv. www.mdpi.com/journal/mineral