GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172216
Semester – VII
Subject Name: Rock Excavation Technology

Type of course: Undergraduate

Prerequisite: Zeal to learn the subject

Rationale: The course is designed to help the student to plan and design various excavation techniques which are used in underground as well as in opencast mine and to develop structures beneath or surface of the earth. For the excavation, properties of the materials, conventional and rapid excavation techniques and latest excavation instruments must be known.

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	**Introduction:** Scope and importance of rock excavation engineering in mining and construction industries; physico-mechanical and geotechnical properties of rocks vis-à-vis excavation method; selection of excavation method. Rock breaking processes: Primary, Secondary and Tertiary, Energy consumption computations	**06**
2	**Blasting Technology in Excavations:** Explosives and their selection criteria for rock excavation; blast design for surface excavations and optimization; advanced blast initiation systems; blast performance evaluation; cast blasting; techno-economic and safety aspects of surface and underground blasting; advances in blast design for underground excavations; contour blasting; computer aided blast designs. Under water drilling and blasting.	**12**
3	**Surface Excavation Technology and Equipment:** Introduction to surface excavating methodologies and equipment, Classification of surface excavating equipment systems vis-a-vis unit operations; Equipment's selection criteria and procedures; application and selection guidelines for different types of equipment like rippers, dozers, scrapers, BWE, continuous surface miners, auger drills;	**12**
4	**Underground Excavation Technology and Equipment** Types of underground excavations: tunnel, shaft, cavern, etc, Theories of rock tool interaction for underground excavation machinery - ploughs, shearers, road headers, continuous miners.	**12**

	Rapid excavation: Tunnel boring machines; selection criteria for cutting tools; parameters influencing location of a tunnel and its design, planning and site -investigation for tunneling, methods of tunneling; Tunneling in soft ground, Excavation of caverns for hydro-electric projects No-Dig technology.	
5	**Instrumentation in Excavation:** Introduction to various instruments in excavation, electronic and manual data generation Bore hole logging system, acoustic/ultrasonic instruments, ground penetrating radars Stress and strain, deformation, convergence measuring instruments, Seismic instruments Concrete testers, non-destructive instruments for excavations, Instrumentation for performance monitoring	**06**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
64%	**18%**	**12%**	**2%**	**2%**	**2%**

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

Text / Reference Books:

1. H.L.Hartman SME, Mining Engineering Hand Book, Society of Mining Engg, USA
2. Hustrulid, Underground mining methods, SME
3. Hustrulid, Open cast mining
4. Dr. Calvin Konya, Rock Blasting and Overbreak Control
5. Stig o Olofsson, Applied explosive technology for construction and mining, APPLEX P O Box 71 S-640 43 ÄRLA SWEDEN
6. Bickel, J.O., Kuesel, T.R., and King, E.H., 1996, Tunnel Engineering Handbook (Second Edition), Chapman & Hall, 544 pages.
7. Bieniawski, Z..T., 1992, Design Methodology in Rock Engineering, A.A. Balkema, 196 pages. rtman : SME Mining Engineering Handbook
8. Whittaker, B. N. and Frith, R. C. (1990): Tunneling: Design, Stability and Construction, London: Institution of Mining and Metallurgy
9. Hoek, E and Brown, E.T. (1980):Underground Excavation in Rock, The Institution of Mining and Metallurgy, London
10. Mahtab, M.A., and Grasso, P., 1992, Geomechanics Principles in the Design of Tunnels and Caverns in Rocks, Elsevier Press, 250 pages.

11. Bieniawski, Z. T. (1984):Rock Mechanics Design in Mining and Tunneling, Balkema

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	To understand the importance rock excavation technology in mining and allied.	10
CO-2	They can know conventional method for economical excavation.	20
CO-3	To know the surface excavation technology and equipment for the excavation.	25
CO-4	To know the underground excavation technology and equipment for the excavation.	25
CO-5	To monitor and asses the data via instrumentation in excavation for safety purpose.	20

List of Experiments:

Following experiments are suggested for Laboratory work

Sr. No	**Practical /Exercise**	**Approx. Hours Required**
1	To study the physico-mechanical and geotechnical properties of rocks.	4
2	To study the rock breaking process.	4
3	Constructional and Operational features of Bucket wheel excavator.	4
4	Constructional and Operational features of surface miner.	4
5	Constructional and Operational features of Tunnel boring machine.	4
6	Constructional and Operational features of continuous miner.	4
7	Constructional and Operational features of road header.	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 operation and working of various machineries use for excavation and processing for dimensional stone.

Major Equipment:

1. Jack Hammer
2. Air compressor

3. Rock strata monitoring equipment
4. Telltale extensometer
5. Piezometer
6. Geophone
7. Rock bolt monitoring device
8. GPR