Course Type	Course Code	Name of Course	L	T	P	Credit
DE11	**MND 410**	**ADVANCED BLASTING TECHNIQUES**	3	0	0	9

Course Objective
Drilling and blasting is the predominant rock breaking technique. It is one of the first unit operation in a mine. The objective of this course is to provide an understanding of advancements in drilling techniques, automation in drilling rigs, advancements in explosives materials, initiating systems, digital systems, blast design and controlled blasting techniques.
Course Outcomes
After going through this course the students will be able to know the advancements which have taken place in drilling technology, explosives engineering, initiating systems and will be in a position to design the blasting in surface and underground mines. They will be able to design the blast efficiently in surface mines or excavations, tunnels, underground mines, and caverns. They will be able to control the blasting hazards such as air over-pressure, flyrock, blast induced ground vibration, dust and fumes. They will also be equipped to design controlled blasts while working near habitation or near sensitive infrastructure.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	***Advancements in drilling techniques-*** Introduction; Types of drilling operations used in rock breakage; Applicability and limitations of different drilling methods vis-à-vis rock types and hole diameter Calculation of drilling costs. **Percussive & Rotary percussive drilling:** Introduction; Fundamentals of percussive & rotary percussive drilling; Top hammer drilling; Down the hole hammer drilling; Advance systems; Drilling parameters and their estimation. **Rotary drilling:** Introduction; Fundamentals of rotary drilling; Drilling parameters and their estimation	6	This will help students to understand about the blast hole drilling mechanism and selection of a drill for surface excavation.
2	***Automation in drilling technology:*** Introduction, MWD technology and its application for rock mass characterisation.	3	This will help students to understand about the MWD concept
3	***Advances in Explosives Engineering:*** Introduction, special types, their properties-: Strength, Detonation velocity, Density, Water resistant, Fume characteristics, Oxygen balance, Completion of reaction, Detonation pressure, Borehole pressure and critical diameter, Sensitivity, Safety in handling & storage qualities, Explosives selection for different rock type, specific problems related to the use of explosives such as desensitization, sympathetic detonation, performance and sensitivity of explosives. Advances in packaged and Bulk explosives manufacturing and loading systems.	6	This will help students to understand about the advances in explosives and their uses.
4	***Digital initiation systems***: Introduction, different initiation systems, electric, non-electric and digital initiation systems, Advances in remote firing systems of digital detonators.	3	This will help students to understand about the advances in initiating systems and their uses.
5	***Blast design for surface mines & quarries :*** Introduction, rock mass strength properties, Elastic properties, Wave velocity, Rock density, Porosity, Mineral composition, grain size and internal friction, Structural discontinuities, Presence of cavities, Variability of strata, Ground water and moisture content, on blast performance. Design objectives, Fragmentation, Bench geometry, Blasthole diameter, Blasthole inclination, burden, Spacing, Sub-grade drilling,	6	The student will be able to design the surface blast round as well as the outcomes of the blast design.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
	Stemming, Powder factor/specific charge, Energy factor.		
6	***Rock fragmentation by blasting:*** Theory of blasting, laws of comminution, Rock fragmentation process and role of discontinuities and in-situ stresses, explosives energy delivery and partitioning, fragmentation prediction and measurement, Dust and Fines generation and control, throw, dig ability, effects of geology	3	The students will understand the various techniques to do fragmentation assessment.
7	***Design of tunnel blasts:*** Introduction, Explosives for tunnel blasting, blast design for rapid development, performance assessment.	3	The students will understand the tunnel blast round design
8	***Rock Damage and over break control in tunneling and cavern blasting***: Advanced theory and application of explosives in excavation. Damage and special blasting techniques used in Controlled blasting and blast design methods-.Pre-splitting, profiling, cushion blasting, trace blasting, and post blasting techniques.	4	The students will understand the controlled blasting techniques
9	***Secondary blasting:*** Design of Pop shooting and plaster shooting techniques for oversize boulder breakage.	1	The students will understand the secondary blasting techniques
10	***Environmental hazards of blasting:*** Understanding the generation of Air Over pressure, blast induced ground vibration, and fly rock in blasting and their mitigation measures.	3	The students will understand the problems generated due to blasting and their remedial measures.
11	***Blast Instrumentation:*** Blast instrumentation for blast performance evaluation and improvement.	2	The students will understand the instruments used for measuring the blast results
12	***Application of digital tools in blast optimisation and analysis***	2	The students will understand various software for blast design

Text books:

1. Rock Blasting and Overbreak Control- C.J. Konya
2. Drilling and blasting of rocks – Jimeno, Carcedo, Jimeno

Reference books:

1. Blaster's Handbook, International Society of Explosives Engineers
2. Blasting principles for open pit mining- William Hustrulid
3. Rock Blasting and Explosives Engineering, Per Anders Persson, Roger Holmberg and Jaimin Lee, CRC Press

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