

Blasting Technology

[5th Semester, Third Year]



Course Description

Offered by Department
Mining Engineering

Credits
3-1-0, (4)

Status
PC

Code
MI105101MI

[Pre-requisites: Basics of Mining Engineering, Surface Mining, Underground Coal Mining]

Course Objectives

The course is designed for student to understand various types of explosives used in mines, properties and initiation. It also helps the student to understand different approaches used for underground and surface blasting practices. It also depicts the various environmental impacts of blasting in mines and mitigation techniques.

Course Content

UNIT 1: COMMERCIAL EXPLOSIVES

Classification of explosive, important properties of explosives, Composition of commercial explosives, Applications, Packed and Bulk explosive system.

UNIT 2: INITIATION SYSTEM, STORAGE AND TRANSPORTATION OF EXPLOSIVES

Detonators, Safety fuse, Detonation cord, Detonating relay, Non-electric initiation system, Electronic detonators, Primers and boosters, Exploder and other blasting tools, Storage, transportation and disposal of explosives.

UNIT 3: SURFACE BLAST DESIGN

Theory of rock breakage, Bench blasting terminology, Estimation of spacing, burden, stemming length, sub-grade drilling etc., Charge calculation, Initiation sequence, delay timing, Decking decoupling, Secondary Blasting. Blast design in jointed rock mass & special conditions like watery holes & hot holes. Effect of surface blasting on underground excavations.

UNIT 4: UNDERGROUND BLAST DESIGN

Underground blasting terminology, cut patterns, blasting in sinking shaft, underground coal mine blasting. Effect of underground blasting on important surface structures.

UNIT 5: ENVIRONMENTAL IMPACT OF BLASTING

Blast induced ground vibration – standards, measurement, damage criteria; Air over Pressure and Fly rock, Blasting Fumes, Controlled Blasting Techniques.

Course Materials

Required Text: Text books

1. Surface blast design, Calvin J Konya; Edward J Walter; (1990)
2. The modern technique of rock blasting, Author:ULangefors; BjörnKihlströmPublisher: New York, Wiley 1967
3. Dr G. K. Pradhan, Explosives & Blasting Techniques, Mintech Publications, Bhubaneswar.

Optional Materials: Reference Books

1. Indian Explosive Act 1884 and Rules 2008.
2. Engineering Rock Blasting Operations 1997by S. Bhandari

Underground Metal Mining

[5th Semester, Third Year]



Course Description

Offered by Department
Mining Engineering

Credits
3-1-0, (4)

Status
PC

Code
MI105102MI

[Pre-requisites: Basics of Mining Engineering]

Course Objectives

The course is designed for student to understand underground mining methods used for development and extraction of ore deposits. The students are also made aware with the case studies of some of the metal mines. It also introduces the advancements in the field of underground metal mining to the student.

Course Content

UNIT 1: General

Status and scope of Underground metal mining methods; Definitions of important terms used in underground metal mining. Classification of mining methods; Factors affecting the choice of mining methods.

UNIT 2: Development

Mode of access; Variables affecting the choice of mode of access; Crosscuts, Levels, Raises, Winzes, Ore passes - Their method of drivages with the description of various unit operations; Introduction to Raise boring and introduction to tunnel boring.

UNIT 3: Stoping Methods-I

Overhand, Underhand and Breast stoping methods; Open stoping; Vertical Crater Retreat method; Sub level stoping, Room and Pillar method, Resuing method.

UNIT 4: Stoping Methods-II

Shrinkage stoping; Cut and fill stoping, Square set stoping, Sub level caving, Block caving, Top slicing.

UNIT 5: Metal Mining Practices in India and Abroad

Case Studies of selected metal mines, Advances in metal mining technologies.

Course Materials

Required Text: Text books

1. Elements of Mining Technology Vol. 2–2016. by D. J. Deshmukh
2. Underground mining methodsSME Mining Engineering Handbook 2nd Edition Howard L. Hartman
3. Introductory Mining Engineering Hartman Howard L. 2nd Edition

Optional Materials: Reference Books

1. SME Mining Engineering Handbook 2nd Edition Howard L. Hartman

Rock Mechanics

[5th Semester, Third Year]



Course Description

Offered by Department
Mining Engineering

Credits
3-1-0, (4)

Status
PC

Code
MI105103MI

[Pre-requisites:No]

Course Objectives

The course is to develop an understanding of the engineering properties of rock, various rock mass classifications and its applications for design of mine structures, rock failure theories, in-situ stresses in rock, and the fundamental concepts and principles of rock mechanics used for the design of foundations, slopes and underground openings in rock.

Course Content

UNIT 1:

Application of rock mechanics in mining, Definition of important terms used in Rock mechanics, Classification of rock mass, Parameters of rock mass classification, Objective & Importance of rock mass classification, Terzaghi Rock load theory. Stand up time, RQD, Q system and Bieniawski's Geomechanics classification of rock mass, RSR system, CMRI-ISM Geomechanics Classification, GSI etc.

UNIT 2:

Rock properties, Physio-mechanical properties of rock, Preparation and testing of specimen in the laboratory, ISRM standards, Determination of Physico-mechanical properties of rock as per ISRM standard testing procedures, Strength indices and their importance. Point load, Protodyaknov, Impact and Cone Indenter strength Index. Hardness and abrasivity of rock.

UNIT 3:

Rock as an elastic medium, Principle of elastic analysis, Rheological properties of rock, Importance of rheological models, Different types of rheological models, Propagation of elastic wave in rock media, Dynamic properties of rocks, Anisotropy and Creep.

UNIT 4:

Principal stress and Principal plane, Analytical method of determining the magnitudes and directions of normal and shear stress on failure plane, Mohr's circle, Theories of failure of rock, Different modes of failure of rock, Mohr's theory, Mohr's Coulomb failure criteria, Griffith's theory, Empirical theories of failure of rock mainly Bieniawski and Hoek and Brown failure criteria, Estimation of rock mass strength using failure criteria.

UNIT 5:

Earth stresses, Importance of measurements of in situ stress, measurements of in situ stress by Flat jack, Over coring and Hydraulic fracturing technique, Design of circular and elliptical openings. Application of in-situ stresses and determination of safe span of roof.

Course Materials

Required Text: Text books

1. Development of rock engineering Rock Mechanics 1969, by Obert and Duvall 1967
2. Introduction to Rock Mechanics: Goodman, Richard E., Second Edition
3. Fundamentals of Rock Mechanics, 4th Edition, John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman
4. Rock Mechanics for Engineers by B.P. Verma, 1985
5. Engineering Rock Mass Classification by Z.T. Bieniawski, 1976
6. Fundamentals and Applications of Rock Mechanics, 2016 by Deb Debasis, Verma Abhiram Kumar

Optional Materials: Reference Books

1. Rock Mechanics: For underground mining 3rd Edition by Barry H.G. Brady, E.T. Brown

Mine Hazards and Rescue

[5th Semester, Third Year]



Course Description

Offered by Department
Mining Engineering

Credits
3-o-o, (3)

Status
PE

Code
MI105201MI

[Pre-requisites: Mining Environment- I , Mining Environment- II]

Course Objectives

The objective of the course is to introduce different types of mining hazards and its management.

Course Content

UNIT 1 : SPONTANEOUS HEATING

Causes, detection and preventive measures in underground and surface coal mines, control of spontaneous heating in stacks and dumps. Case studies.

UNIT 2: MINE FIRES

Mine fires, control of fires and fires extinguishers, study of atmosphere behind sealed off areas, fire stopping and sealing off an area, pressure balancing, conditions and procedure of reopening a sealed off area, firefighting organization. Fires in opencast mines and surface storage systems, emergency organization in mines. Case studies.

UNIT 3: EXPLOSION

Fire damp and coal dust explosions, their causes and prevention, stone dust and water barriers, investigations of explosion. Case studies.

UNIT 4: MINE INUNDATION

Causes and precautionary measures, bulk head doors, barriers, dams, their design, precautions to be taken while approaching old workings, Burnside drilling apparatus, recovery of flooded mines and dewatering of old workings. Case studies.

UNIT 5: RESCUE AND RECOVERY

Types of rescue equipment and their use, features of rescue stations and rescue rooms, first aid appliances, training of personnel, and organization of rescue and recovery work during mine fires, explosion, inundation. Case studies.

Course Materials

Required Text: Text books

1. *Mine Ventilation & Environment*, Misra, G.B., Dhanbad Publishers, Dhanbad, 1994
2. *Elements of Mining Technology Vol. 2–2016*. by D. J. Deshmukh
3. Subsurface Ventilation and Environmental EngineeringAuthors: McPherson, M.J. 1993
4. Mine Disasters and Mine Rescue Ramlu M. A. 2006, 2nd Edition.

Optional Materials: Reference Books

1. Occupational Safety and Health: Fundamental Principles and Philosophies by Charles D. Reese
2. Safety in Mines by Kejriwal, B. K. (2002)

Novel Methods of Mining

[5th Semester, Third Year]



Course Description

Offered by Department
Mining Engineering

Credits
3-0-0, (3)

Status
PE

Code
MI105202MI

[Pre-requisites: Basics of Mining Engineering]

Course Objectives

The objective of the course is to help the student in understanding the different novel mining methods presently in practice.

Course Content

UNIT 1:

Borehole Mining: Borehole mining of coal, uranium, Sulphur. Drilling, maintenance services, Jet Cavitations and fracturing, Solution mining of important minerals, leaching.

Coal Bed Methane: Coal Fundamentals and Geology, Key Coal Properties, Coal Permeability, Measurement of Coal bed Gas Content, Elements of a CBM, Isotherms, and Recovery Factor, Development Considerations, Well Design and Drilling, Gas Recovery & Well Performance.

UNIT 2:

Coal Gasification: Introduction to gasification: Chemical reactions, Process technologies: Coal Liquefaction, Underground gasification – principles and potential, Conversion of coal to syngas, Impact of coal properties on gasification. Case studies in India and abroad.

UNIT 3:

Highwall mining: Introduction, applicability, types of high wall mining equipments, Case studies in India and abroad.

UNIT 4:

Hydraulic Mining: Introduction, Process of hydraulic mining, hydro monitors, water jets, surface and underground layouts, merits and impacts.

UNIT 5:

Mining of placer deposits, Ocean Floor Mining, Deep ocean exploration, sea bed mining, ocean floor nodules mining, technology, dredgers and other machines for mining and transport

Course Materials

Required Text: Text books

- Underground Mining Methods SME Mining Engineering Handbook 2nd Edition Howard L. Hartman
- Introductory Mining Engineering : Hartman 2nd Edition,
- Society of Mining Engineering Handbooks –Vol. I and II

Optional Materials: Reference Books

- Techniques in Underground Mining - Selection : Richard E. Gertsch et al, SME 1998
- Underground Mining Methods: Engineering Fundamentals and International Case Studies: A. Hustrulid, 2001

Rock Mechanics Lab

[5th Semester, Third Year]



Course Description

Offered by Department
Mining Engineering

Credits
0-0-2, (1)

Status
PC

Code
MI105401MI

[Pre-requisites:No]

Course Objectives

The course involves hands on laboratory exercises for measurement of various engineering properties of rocks.

Course Content

List of Practical:

1. Determination of Density, porosity and moisture content of rock sample by ISRM standard method.
2. Determination of slake durability strength index of rock sample by ISRM standard method.
3. Determination of point load strength index of rock sample.
4. Determination of Protodyakonov strength index of rock sample.
5. Determination of Uniaxial Compressive strength of rock sample by ISRM standard method.
6. Determination of Tensile strength of rock sample by Brazilian method.
7. Determination of Single Shear and Double Shear strength of rock sample.
8. Determination of cohesion and angle of internal friction of rock sample by tri-axial tests using ISRM standard method.
9. Determination of Young' Modulus of rock sample by ISRM standard method
10. Determination of optimum moisture content and maximum dry density of dump material by Procter compaction test.

Course Materials

Required Text: Text books

1. Development of rock engineering Rock Mechanics 1969 and by. Obert and Duvall
2. Department Rock Mechanics Laboratory Manual

Blasting Technology Lab

[5th Semester, Third Year]



Course Description

Offered by Department
Mining Engineering

Credits
0-0-2, (1)

Status
PC

Code
MI105402MI

[Pre-requisites: Basics of Mining Engineering, Surface Mining, Underground Coal Mining]

Course Objectives

The course involves hands on laboratory exercises for measurement of various blasting properties.

Course Content

List of Practical:

1. Blast Induced ground vibration and development of ground vibration predictor equation
2. Measurement of air over pressure, noise, and blasting fumes.
3. Measurement of unconfined VOD of Explosives
4. Measurement of in hole VOD of Explosives column
5. Fragmentation analysis using WIPFRAG software
6. Study of various types of Exploders
7. Study of various blasting tools
8. Study of bulk delivery system of explosive
9. Study of various controlled blasting techniques
10. Design of Pattern of holes in surface and underground mines

Course Materials

Required Text: Text books

1. Surface blast design, Calvin J Konya; Edward J Walter; (1990)
2. Blasting Laboratory Manual