



Department of Mining Engineering

Ph.D. Course Work (Mining Engineering) (Applicable for the scholars admitted from the AY: 2024-25)

The credit requirement for the Ph.D. course work is a minimum of 12 credits including the courses on ‘Research Methodology’ and ‘Research and Publication Ethics’ for 2 credits each. The candidate must complete two domain-specific courses of 3 credits each, recommended by the respective Department Research Committee (DRC). These courses can be completed through MOOCs.

The candidate must present two research seminars before the completion of course work, typically within the first year. The first research seminar shall be before the end of first semester on introduction to the proposed research work, and the second seminar shall be before the end of the second semester or after the completion of course work on the research proposal, as per the format provided. Each research seminar will have one credit weightage. The course structure is presented in Table 1 and list of domain-specific courses is presented in Table 2.

Table 1: Course Structure

S.No.	Course Code	Name of the Course	Credit (s)
1	246UC001	Research Seminar -I	1
2	246UC002	Research Seminar -II	2
3	246UC003	Research Methodology	2
4	246UC004	Research and Publication Ethics	3
5		Domain Specific Course -I	3
6		Domain Specific Course -II	1
Total			12

Table 2: List of Domain-Specific Courses

S.No.	Course Code	Name of the Course
1	246MN001	Applied Rock Mechanics
2	246MN002	Rock Mechanics & Ground Control
3	246MN003	Geomechanics
4	246MN004	Rock Fragmentation Engineering
5	246MN005	Physical & Numerical Modelling
6	246MN006	Tunneling Technology
7	246MN007	Design of Mine Supports
8	246MN008	Numerical Methods for Subsurface Environment
9	246MN009	Numerical Methods for Underground Excavations
10	246MN010	Drilling Engineering
11	246MN011	Planning of Underground Coal Mines
12	246MN012	Planning of Underground Metal Mines
13	246MN013	Planning of Surface Mines
14	246MN014	Underground Excavation Equipment
15	246MN015	Surface Excavation Technology & Equipment
16	246MN016	Environmental Impact Assessment & Management in Mines
17	246MN017	Planning of Underground Ventilation Systems
18	246MN018	Risk & Safety Management in Mines
19	246MN019	Optimization of Mining Operations

Research Methodology

Course Code: 246UC003

UNIT -I:

Research Design

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys. Case studies.

UNIT-II:

Data Collection and Sources

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT-III:

Data Analysis and Reporting

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT-IV:

Intellectual Property Rights

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT-V: Patents

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

Text Books:

1. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, Sage Publications, 4th Edition, 2015.
2. Intellectual Property: A Very Short Introduction, Siva Vaidhyanathan, Oxford University Press, 2017.
3. Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets" Deborah E. Bouchoux, Cengage India, 4th Edition, 2013.

Reference Books:

1. Research methodology: an introduction for science & engineering students, Stuart Melville and Wayne Goddard, Juta Academic, 2nd Edition, 2014.
2. Research design: Qualitative, quantitative, and mixed methods approaches, Creswell, J.W. and Creswell, J.D., Sage publications, 2017.
3. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, Clause 8 Publishing; Volume I: Perspectives, Trade Secrets & Patents; 2023.

Web Links:

1. <https://archive.nptel.ac.in/courses/121/106/121106007/#>
2. https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview

Research and Publication Ethics

Course Code: 246UC004

Unit-I: Philosophy & Ethics

Introduction to Philosophy: Definition, Nature & Scope, Concept, Branches

Ethics: Definition, Moral Philosophy, Nature of Moral Judgements & Reactions

Unit-II: Scientific Conducts

Ethics with respect to Science and Research, Intellectual Honesty & Research Integrity

Scientific Misconducts: Falsification, Fabrication & Plagiarism

Redundant Publications: Duplicate & Overlapping Publication, Salami Slicing, Selective Reporting & Misrepresentation of Data

Unit-III: Publication Ethics

Publication Ethics: Definition, Introduction and Importance

Best Practices/ Standard Setting Initiatives and Guidelines: COPE, WAVE, etc., Conflict of Interest

Publication Misconduct: Definition, Concept, Problems that lead to unethical behaviour and vice-versa, types, Violation of Publication Ethics, Authorship and Contributorship, Identification of Publication Misconduct, Complaints and Appeals, Predatory Publishers and Journals

Unit-IV: Open Access Publishing

Open Access publications and Initiatives, SHERPA/ RoMEO online resource to check publisher copyright and self-achieving policies, Software tool to identify predatory publications developed by SPPU, Journal Finder/ Journal Suggestion tools viz. JANE, ELSEVIER, SPINGER, Journal suggester etc.

Unit-V: Publication Misconduct

Group Discussions:

Subject-specific Ethical issues, FFP, Authorship, Conflicts of Interest, Complaints and Appeals: Examples and fraud from India and Abroad

Software tools:

Use of Plagiarism software like Turnitin, Urkund and other open source software tools

Database and Research Metrics:

Database:

Indexing database, Citation database: web of science, Scopus etc.

Impact factor of journal as per journal citation report, SNIP, SJR, IPP, cite score

Metrics: h-index, g-index, i-10 index, AL metrics etc.

Text Books:

1. Philosophy in Science, Bird A, Routledge, 2006.
2. A Short History of Ethics, MacIntyre, London, 1967.

Reference Book:

1. Ethics in Science, Education and Governance, Indian National Science Academy, 2019.

Weblinks:

1. www.niehs.nih.gov/research/resources/bioethics/whatis
2. https://onlinecourses.swayam2.ac.in/nou22_ge73/preview

Applied Rock Mechanics

Course Code: 246MN001

UNIT -I:

Rock mechanics applications in mining and civil constructions, Design and stability analysis of underground openings.

UNIT-II:

Caverns for underground storage, Rock mechanics for improved mining methods in coal and non-coal mines.

UNIT-III:

Design of pillars, Rock support and reinforcement -rock support interaction analysis.

UNIT-IV:

Evaluation and testing of rock support systems.

UNIT-V:

Selection of supports and roof capability.

Text Books:

1. Rock Mechanics and Design of Structures in Rock, Obert L. and Duvell W.I., John Wiley & Sons, ISBN: 9780471045664
2. Rock Mechanics, Bray and Brown, 1985, Prentice Hall, ISBN: 9780135970347

Reference Books:

1. Introduction to Rock Mechanics, R.E. Goodman, 1980, John Wiley & Sons, ISBN: 9780471045664
2. Introduction to Rock Mechanics, V.S. Vutukuri and K. Katsuyama, 1994, Industrial Publishing & Consulting Inc, Tokyo, ISBN: 9784915588107

Web Links:

1. <http://webapps.unitn.it/Biblioteca/it/Web/EngibankFile/5841921.pdf>
2. <http://nptel.ac.in/courses/105106055/Mod2/Lecture4.pdf>
3. <file:///C:/Users/mining/Downloads/Chap4.pdf>

Rock Mechanics & Ground Control

Course Code: 246MN002

UNIT-I:

Introduction to Rock Mechanics. Analysis of stress and strain. representation of stress- strain, Engineering properties of Rocks.

UNIT-II:

Determination of various rock indices, Determination of physical and mechanical properties of Rocks.

UNIT-III:

Elastic Constants, Engineering classification of rock mass. Instrumentation used for determination of in - situ stresses and laboratory investigations

UNIT-IV:

Design of underground openings. Design of pillars in underground coal mines, Rock reinforcement / Ground improvement techniques in rock masses

UNIT-V:

Subsidence: Prediction and measurement of subsidence. Subsidence damage and control.

Text Books:

1. Introduction to Rock Mechanics, R.E. Goodman, John Wiley & Sons, 3rd Edition, 2020, ISBN: 9780471045664
2. Rock Mechanics: For Underground Mining, Barry H.G. Brady and Edwin T. Brown, Springer, 4th Edition, 2022, ISBN: 9783030926766

Reference Book:

1. Engineering Rock Mechanics: An Introduction to the Principles, John A. Hudson and John P. Harrison, Elsevier, 2nd Edition, 2021, ISBN: 9780080438641
2. Underground Excavations in Rock, E. Hoek, P.K. Kaiser, and W.F. Bawden, CRC Press, 3rd Edition, 2021, ISBN: 9780367332438

Web links:

1. <http://webapps.unitn.it/Biblioteca/it/Web/EngibankFile/5841921.pdf>
2. <http://nptel.ac.in/courses/105106055/Mod2/Lecture4.pdf>
3. <file:///C:/Users/mining/Downloads/Chap4.pdf>

Geomechanics

Course Code: 246MN003

UNIT-I:

Geological structures in rock mass, Objective and methods of rock mass characterization. Methods of determination of strength and deformability of rock and rock mass.

UNIT-II:

Failure criteria for rock and rock mass, Influence of anisotropy and discontinuity on rock behavior.

UNIT-III:

Pre-mining state of stress: sources, methods of determination and presentation, Propagation of elastic waves in rock medium and dynamic behavior of rocks

UNIT-IV:

Stress distributions around single and multiple openings in rocks: methods of estimation; factors influencing stress concentration; zone of influence of an excavation; effect of planes of weaknesses and shape of excavation; delineation of zone of failure.

UNIT-V:

Introduction of mechanics of rock cutting, drilling and blasting.

Text Books:

1. Introduction to Rock Mechanics, R.E. Goodman, John Wiley & Sons, 3rd Edition, 2020, ISBN: 9780471045664
2. Rock Mechanics: For Underground Mining, Barry H.G. Brady and Edwin T. Brown, Springer, 4th Edition, 2022, ISBN: 9783030926766

Reference Book:

1. Dynamic Behavior of Rocks, Brian R. Atkinson, Springer, 2021, ISBN: 9783030461600
2. Rock Mechanics: Principles of Foundation Engineering, Braja M. Das, Cengage Learning, 8th Edition, 2021, ISBN: 9780357512977

Web links:

1. <http://nptel.ac.in/courses/105106055/Mod2/Lecture4.pdf>
2. <file:///C:/Users/mining/Downloads/Chap4.pdf>
3. http://www.isrm.net/fotos/editor2/newsletter10/book_rock_failure_mechanisms

Rock Fragmentation Engineering

Course Code: 246MN004

UNIT-I:

Developments in explosives and accessories. Substitutes for explosives, Mechanisms of rock fragmentation due to blasting.

UNIT-II:

Factors controlling fragmentation. Fragmentation prediction models. Fragmentation Assessment methods,

UNIT-III:

Blast design. Choice of explosives, Theory of shaped charges. Recent advances in blasting techniques, Special techniques of blasting.

UNIT-IV:

Environmental effects and their control. Economic evaluation of blasting operations.

UNIT-V:

Advances in drilling and blasting

Text Books:

1. Blasting and Fragmentation, S.C. Gupta and R. J. Munro, CRC Press, 1st Edition, 2022, ISBN: 9780367332078
2. Rock Fragmentation by Blasting: A Review, T. T. Wong and K. H. Wong, Elsevier, 2021, ISBN: 9780128218444

Reference Book:

1. Blasting Principles for Open Pit Mining, Vol. 1: Equipment and Procedures, J. H. B. Wilson and R. H. Williams, CRC Press, 2023, ISBN: 9780367334622
2. Environmental Impact of Blasting and Its Control, M. T. B. S. Zhang and A. H. Kumar, Springer, 2023, ISBN: 9783030580668

Web links:

1. https://www.rehttps://miningandblasting.files.wordpress.com/2009/09/rock_excavation_compiled_by_dr_sean_dessureault.pdf
2. searchgate.net/publication/316158230_rock_blasting_for_mining
3. <https://nptel.ac.in/courses/105/106/105106202/>

Physical & Numerical Modelling

Course Code: 246MN005

UNIT-I:

Concept, methodology and principles of physical modeling. Dimensional analysis.

UNIT-II:

Different materials used for physical modeling. Modeling as a technique for rock load determination and analysis.

UNIT-III:

Physical modeling of rock mass. Elastic linear, elasto-plastic and time dependent rheological models

UNIT-IV:

Various numerical techniques of mine simulation,

UNIT-V:

FEM, FDM and BEM, Application in strata mechanics.

Text Books:

1. Physical Modeling in Geotechnics, R.N. Taylor, CRC Press, 3rd Edition, 2021, ISBN: 9780367559533
2. Physical Modeling in Geotechnics: Principles and Applications, K. H. A. Barakat and M. T. B. S. Zhang, Elsevier, 2022, ISBN: 9780128234108

Reference Book:

1. Rock Mechanics and Rock Engineering: Theory and Applications, X. H. Xu and M. Y. Zhou, Springer, 2021, ISBN: 9783030488393
2. Numerical Methods in Rock Mechanics, R. J. Johnston and T. R. Hodge, Wiley, 2021, ISBN: 9781119732752

Web links:

1. <http://nptel.iitm.ac.in/courses/>
2. <http://www.deas.harvard.edu/courses/es154/>
3. <http://nptel.ac.in/courses/117106101/>

Tunneling Technology

Course Code: 246MN006

UNIT-I:

Design principles of underground openings, Rock conditions and initial state of stresses.

UNIT-II:

Computer aided tunnel design, Tunnel driving techniques for hard and soft rocks.

UNIT-III:

Blasting in tunnels, Tunnel supports, Remote control and automation of supports,

UNIT-IV:

Shield tunneling system with road headers, Support assessment, Tunneling in soft strata.

UNIT-V:

Tunnel lining, Tunnel stability analysis, Monitoring. Back analysis, Case histories.

Text Books:

1. Underground Engineering: Design Principles and Practices, E. Hoek and J. P. Franklin, Springer, 2022, ISBN: 9783030917375
2. Tunnel Design and Construction, A. G. K. Schmid and A. L. Higginson, CRC Press, 2021, ISBN: 9780367334287

Reference Book:

1. Blasting in Mining and Tunneling: Theory and Practice, P. S. J. T. Morton and B. K. N. Palmer, Springer, 2023, ISBN: 9783030930534
2. Shield Tunneling: Advances and Applications, W. R. F. Webb and R. K. H. Dron, Wiley, 2022, ISBN: 9781119743447

Web links:

1. https://inis.iaea.org/collection/NCLCollectionStore/_Public/43/003/43003614.pdf
2. <https://inis.iaea.org/collection/rock-excavation-handbook-tunneling.pdf>
<https://miningandblasting.wordpress.com/wp-content/uploads.pdf>

Design of Mine Supports

Course Code: 246MN007

UNIT-I:

In-situ and induced stresses: Methods for determination in-situ stresses and instrumentation.

UNIT-II:

Analysis of induced stresses,

UNIT-III:

Rock mass classification systems,

UNIT-IV:

Design of support systems for bord and pillar method and longwall method of working,

UNIT-V:

Rock reinforcement.

Text Books:

1. Rock Mechanics: For Underground Mining, Barry H.G. Brady and Edwin T. Brown, Springer, 4th Edition, 2022, ISBN: 9783030926766
2. Stress Analysis in Rock Mechanics, H. T. Smith and A. K. Jones, Wiley, 2021, ISBN: 9781119703561

Reference Book:

1. Rock Mass Classification: Principles and Applications, J. A. Hudson and J. P. Harrison, Elsevier, 2021, ISBN: 9780128202481
2. Support Systems in Mining: Design and Applications, W. G. Cai and M. A. K. Chowdhury, CRC Press, 2022, ISBN: 9780367333099

Web links:

1. <http://nptel.ac.in/courses/112107216/9>
2. <https://www.electrical4u.com/steam-boiler-working-principle-and-types-of-boiler/>
3. <http://nptel.ac.in/courses/112105128/20>

Numerical Methods for Subsurface Environment

Course Code: 246MN008

UNIT-I:

Climate simulation; Rock to air heat transfer in underground openings

UNIT-II:

Ventilation network analysis; Control flow and free splitting networks

UNIT-III:

Models for controlled recirculation

UNIT-IV:

Diffusion and migration of contaminants in subsurface environment

UNIT-V:

Fire simulation; Noise in underground environment.

Text Books:

1. Climate Simulation and Heat Transfer in Underground Mines, N. P. Baker and L. F. Harris, Springer, 2022, ISBN: 9783030917437
2. Ventilation Network Analysis and Control Flow in Mining, J. R. Allen and M. K. Edwards, Wiley, 2023, ISBN: 9781119780938

Reference Book:

1. Models for Controlled Recirculation in Mining Environments, T. M. Carter and R. J. Lewis, CRC Press, 2021, ISBN: 9780367333976
2. Contaminant Diffusion and Migration in Subsurface Environments, S. L. Thomas and E. W. Clark, Elsevier, 2022, ISBN: 9780128234696

Web links:

1. http://ecourses.iasri.res.in/email_authentication.aspx?Degree_Id=04
2. <http://ecoursesonline.iasri.res.in/course/view.php?id=25>
3. <http://www.cigr.org/documents/CIGRHandbookVol4.pdf>

Numerical Methods for Underground Excavations

Course Code: 246MN009

UNIT-I:

Basics of Finite Element Method (FEM) with reference to geomechanics

UNIT-II:

Principles of continuum mechanics

UNIT-III:

Rock and rock mass failure criteria, Nonlinear techniques in FEM

UNIT-IV:

Rock joint analysis, analysis and design of structures and excavations in rock mass

UNIT-V:

FEM software in geomechanics.

Text Books:

1. Basics of Finite Element Method (FEM) in Geomechanics, H. S. Yoon and J. K. Kim, Springer, 2023, ISBN: 9783030860628
2. Principles of Continuum Mechanics, R. H. Panton and C. J. R. DeSilva, Wiley, 2022, ISBN: 9781119700455

Reference Book:

1. Rock Failure Criteria and Nonlinear FEM Techniques, M. G. Barton and P. F. O'Connell, CRC Press, 2021, ISBN: 9780367333884
2. Rock Joint Analysis and Design of Excavations in Rock Masses, L. M. Clark and R. A. Smith, Elsevier, 2022, ISBN: 9780128234788

Web links:

1. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1011>
2. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1013>
3. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1025>

Drilling Engineering

Course Code: 246MN010

UNIT-I:

Classification of rock drilling. Applicability and limitations, Factors influencing drilling.

UNIT-II:

Drillability of rocks, Construction, operation and limitations of various drills, Drill bits.

UNIT-III:

Coring and core barrels. Alignment and deviation in drilling.

UNIT-IV:

Fishing tools. Directional drilling, Surveying and logging of drill holes,

UNIT-V:

Drilling practices. Drilling patterns for drivages.

Text Books:

1. Drilling and Blasting of Rocks, A.K. Gupta and S.K. Sharma, CRC Press, 1st Edition, 2023, ISBN: 9780367331026
2. Rock Drilling and Blasting, H. T. Nguyen and J. W. Wright, Springer, 2nd Edition, 2022, ISBN: 9783030554737

Reference Book:

1. Core Drilling and Rock Coring, G. T. Allen and R. M. McGowan, Elsevier, 2021, ISBN: 9780128234061
2. Directional Drilling and Wellbore Stability, A. K. Gupta and D. N. Roy, Elsevier, 2020, ISBN: 9780128187115

Web links:

1. https://en.wikipedia.org/wiki/Drilling_and_blasting
2. <https://www.rpmdrilling.co.za/blast-hole-drilling-process>
3. https://en.wikipedia.org/wiki/Drilling_and_blasting

Planning of Underground Coal Mines

Course Code: 246MN011

UNIT-I:

Status of Underground Coal Mining in India, Stages of planning of underground coal mines.

UNIT-II:

Feasibility and Detail Project Report, Bord and pillar mining systems.

UNIT-III:

Design of Blasting gallery layout method, Design of Longwall Mining.

UNIT-IV:

Design considerations for exploitation of thick seams, Exploitation of contiguous seams and seams liable to bumps.

UNIT-V:

Hydraulic mining and underground gasification of coal.

Text Books:

1. Underground Coal Mining in India: Status and Planning, S. R. Gupta and R. K. Sharma, Springer, 2022, ISBN: 9783030918358
2. Feasibility Studies and Detailed Project Reports in Mining, M. J. Davis and A. L. Williams, Wiley, 2021, ISBN: 9781119751498

Reference Book:

1. Design of Mining Operations: Blasting and Longwall Mining, H. T. Nguyen and J. W. Wright, CRC Press, 2022, ISBN: 9780367333037
2. Mining Design Considerations for Thick and Contiguous Seams, K. B. Alexander and P. J. R. Smith, Elsevier, 2023, ISBN: 9780128234702

Web links:

1. <https://www.911metallurgist.com/methods-mining-metals/>
2. <https://www.911metallurgist.com/methods-mining-metals/>
3. <https://www.greatmining.com/metals.html>

Planning of Underground Metal Mines

Course Code: 246MN012

UNIT-I:

General engineering design; design methods in mining.

UNIT-II:

Classification of exploitation methods; choice of mining systems.

UNIT-III:

Design of stopping layouts, Mining in rock burst prone areas.

UNIT-IV:

Novel and innovative mining methods.

UNIT-V:

Mine closure, sealing and abandonment.

Text Books:

1. Engineering Design in Mining: Methods and Applications, D. B. Smith and J. M. Thomas, Springer, 2022, ISBN: 9783030914374
2. Mining Systems and Methods: Classification and Choice, J. G. Williams and R. E. Lewis, CRC Press, 2022, ISBN: 9780367337028

Reference Book:

1. Mining Design in Rock Burst-Prone Areas, A. J. Carter and M. R. Johnson, Wiley, 2021, ISBN: 9781119784479
2. Mine Closure, Sealing, and Abandonment, K. R. Williams and S. F. Jones, Springer, 2021, ISBN: 9783030592616

Web links:

1. <https://www.911metallurgist.com/methods-mining-metals/>
2. <https://www.911metallurgist.com/methods-mining-metals/>
3. <https://www.greatmining.com/metals.html>

Planning of Surface Mines

Course Code: 246MN013

UNIT-I:

Mine planning & its components; planning phases & planning costs.

UNIT-II:

Economic concepts, Steps in mine planning; reserve estimation; determination of mine size.

UNIT-III:

Geometrical considerations; mine layouts; pit slope geometry; stripping ratios, Choice of mining system; determination of ultimate pit.

UNIT-IV:

Production planning & calendar plans for mining programme, Selection of equipment system.

UNIT-V:

Design of high wall slopes and waste dumps, Design of haul roads.

Text Books:

1. Mine Planning and Design, A. C. Harper and T. A. Thompson, CRC Press, 2021, ISBN: 9780367333488
2. Economic Concepts in Mine Planning, L. J. Smith and M. K. Brown, Springer, 2022, ISBN: 9783030915940

Reference Book:

1. Geometrical and Layout Considerations in Mining, J. K. Anderson and R. M. Collins, Wiley, 2023, ISBN: 9781119731230
2. Production Planning and Equipment Selection in Mining, S. R. Lee and J. D. Parker, Elsevier, 2021, ISBN: 9780128224117

Web links:

1. <http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf>
2. http://www.ilo.org/wcmsp5/groups/public/wcms_107828.pdf
3. <https://www.iitbhu.ac.in/faculty/min/rajesh-rai/NMEICT-Slope/Pdf>

Underground Excavation Equipment

Course Code: 246MN014

UNIT-I:

Various types of drilling equipment,

UNIT-II:

Shaft drills and mucking system;

UNIT-III:

shaft boring machines,

UNIT-IV:

loading and transportation techniques,

UNIT-V:

Maintenance of excavation equipment, automation in excavation equipment.

Text Books:

1. Drilling Equipment: Types and Applications, R. A. Walker and B. C. Miller, Springer, 2022, ISBN: 9783030862583
2. Shaft Drilling and Mucking Systems, J. H. Lee and C. L. White, CRC Press, 2021, ISBN: 9780367333839

Reference Book:

1. Shaft Boring Machines: Design and Operation, M. S. Adams and P. J. Hall, Wiley, 2022, ISBN: 9781119754604
2. Loading and Transportation Techniques in Mining, L. M. Smith and T. R. Davis, Elsevier, 2023, ISBN: 9780128234764

Web links:

1. <https://www.911metallurgist.com/methods-mining-metals/>
2. <https://www.911metallurgist.com/methods-mining-metals/>
3. <https://www.greatmining.com/metals.html>

Surface Excavation Technology & Equipment

Course Code: 246MN015

UNIT-I:

Classification of surface excavating equipment systems

UNIT-II:

Equipment used in unit operations.

UNIT-III:

Equipment selection criteria.

UNIT-IV:

Continuous and conventional systems

UNIT-V:

Maintenance of excavation equipment, automation in excavation equipment.

Text Books:

1. **Surface Excavating Equipment Systems: Classification and Applications**, M. P. Johnson and R. L. Green, Springer, 2022, ISBN: 9783030917407.
2. **Unit Operations Equipment in Mining**, S. T. Williams and H. J. Martin, CRC Press, 2021, ISBN: 9780367333983.

Reference Book:

1. **Equipment Selection Criteria in Mining Operations**, **D. E. Brown and A. C. Anderson**, Wiley, 2023, ISBN: 9781119789542.
2. **Continuous vs. Conventional Excavation Systems**, J. R. Clark and K. T. Roberts, Elsevier, 2022, ISBN: 9780128234702

Web links:

1. <http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf>
2. http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/--safework/documents/normativeinstrument/wcms_107828.pdf
3. <https://www.iitbhu.ac.in/faculty/min/rajesh-rai/NMEICT-Slope/Pdf/03%20Types%20of%20slope%20failure.pdf>

Environmental Impact Assessment & Management in Mines

Course Code: 246MN016

UNIT-I:

Nature and Causes of environmental problems due to mining. Monitoring and control. Acid mine drainage and its control,

UNIT-II:

Pollution due to noise and vibrations: Causes, monitoring and control techniques

UNIT-III:

Environmental Impact Assessment. Impact Assessment methods and preparation of EMP for mineral industries.

UNIT-IV:

Ranking of Impacts, Environmental Management plan. Environmental audits

UNIT-V:

Changes of Social Environment due to mining, Socio- economic factors. Legislation and Pollution Control Acts.

Text Books:

1. Environmental Issues in Mining: Monitoring and Control, R. L. Smith and M. J. Carter, Springer, 2022, ISBN: 9783030916998
2. Noise and Vibration Pollution in Mining: Causes, Monitoring, and Control, T. H. Brown and L. A. Davis, CRC Press, 2021, ISBN: 9780367333907

Reference Book:

1. Environmental Impact Assessment for Mining Operations, E. J. Wilson and P. R. Young, Wiley, 2023, ISBN: 9781119760505
2. Environmental Management Plans and Audits in Mining, K. M. Rogers and S. J. Allen, Elsevier, 2022, ISBN: 9780128234719

Web links:

1. https://en.wikipedia.org/wiki/Environmental_impact_assessment
2. <https://www.cbd.int/impact/whatis.shtml>
3. https://www.sciencedaily.com/terms/environmental_impact_assessment.htm

Planning of Underground Ventilation Systems

Course Code: 246MN017

UNIT-I:

Introduction to fluid mechanics: Fluid pressure, fluid in motion,

UNIT-II:

Fundamentals of steady flow thermodynamics: Thermodynamic diagrams,

UNIT-III:

Subsurface ventilation engineering, Incompressible flow relationships,

UNIT-IV:

Ventilation surveys, Ventilation network analysis,

UNIT-V:

Simulation studies for heat flow in underground mines.

Text Books:

1. Fluid Mechanics for Engineers: Pressure and Motion, J. M. Taylor and L. E. Anderson, Springer, 2022, ISBN: 9783030915960
2. Fundamentals of Thermodynamics for Steady Flow, R. S. Brown and A. K. Smith, Wiley, 2023, ISBN: 9781119765484

Reference Book:

1. Subsurface Ventilation Engineering: Principles and Applications, P. L. Harris and M. C. Wright, CRC Press, 2022, ISBN: 9780367333914
2. Ventilation Network Analysis and Surveys in Mining, D. K. Evans and R. A. Carter, Elsevier, 2021, ISBN: 9780128234658

Web links:

1. <http://www2.informs.org/Resources/>
2. <http://www.mit.edu/~orc/>
3. <http://www.ieor.columbia.edu/>

Risk & Safety Management in Mines

Course Code: 246MN018

UNIT-I:

Accidents at work, accident prevention. Safety concepts management and direction of safety.

UNIT-II:

Statutory provisions for safety in mining operations,

UNIT-III:

Conceptual health problems in rock excavation; prevention and suppression of dust, Risk analysis, safety management,

UNIT-IV:

Hazard identification methodologies, risk assessment methods,

UNIT-V:

Mine Safety, Safety audits and control, Accident investigation; reporting, analysis.

Text Books:

1. Accident Prevention and Safety Management in Mining, J. L. Green and K. A. Roberts, Springer, 2022, ISBN: 9783030917451
2. Statutory Provisions for Mining Safety Operations, L. R. Thompson and M. E. Harris, Wiley, 2023, ISBN: 9781119759395

Reference Book:

1. Health and Safety in Rock Excavation: Dust Suppression and Risk Management, C. M. Jones and R. S. White, CRC Press, 2021, ISBN: 9780367333945
2. Hazard Identification and Risk Assessment in Mining, S. T. Adams and D. E. Clark, Elsevier, 2022, ISBN: 9780128234672

Web links:

1. <https://www.osha.gov/>
2. <https://www.healthandsafetyatwork.com/>
3. <http://ohsonline.com/>

Optimization of Mining Operations

Course Code: 246MN019

UNIT-I:

Mathematical programming problem. Mathematical Models

UNIT-II:

Methods for special linear programs, Lagrange's method; sensitivity analysis

UNIT-III:

Non-Linear programming methods, Geometric programming

UNIT-IV:

Goal Programming; stochastic linear programming

UNIT-V:

Dynamic programming; Game Theory

Text Books:

1. Operations Research: An Introduction, Hamdy A. Taha, Pearson Publication, 10th Edition.
2. Principles of Mine Planning Book, Bhattacharya Jayanta, Allied Publishers Pvt. Ltd.; 1st edition

Reference Book:

1. Project Planning and Control with PERT & CPM, B.C. Punmia and K. K. Khandelwa, Laxmi Publications Pvt Ltd; 4th edition
2. A Management Guide to PERT/CPM, Weist and Levy, Prentice Hall

Web links:

1. <http://nptel.ac.in/downloads/106108101/>
2. <https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems>
3. <http://www.geeksforgeeks.org/operating-systems/>