THE UNIVERSITY OF BRITISH COLUMBIA Experiential Learning Hub Faculty of Applied Science

UBC

MINING ENGINEERING Industry Guide

Introduction

Mining Engineering is a specialized field focused on the extraction of valuable minerals and natural resources from the earth. It involves a combination of geological, mechanical, civil, and environmental engineering principles to ensure safe, efficient, and sustainable mining operations. Mining engineers design and implement the methods used to locate, extract, and process minerals and metals, and they work to develop techniques that minimize environmental impact while maximizing resource recovery.

Mining engineers are responsible for creating and maintaining the infrastructure of mines, from surface to underground operations. They optimize drilling and blasting techniques, design ventilation and transportation systems, and improve the safety and efficiency of mining equipment. Additionally, they play a key role in addressing global challenges by advancing sustainable mining practices, reducing environmental impacts, and ensuring the long-term viability of mining operations.

Due to the diverse nature of mining engineering, professionals in this field can specialize in various areas, including resource management, environmental protection, mine design, safety, and automation. This offers the opportunity to work on projects that have a significant impact on global industries such as energy, construction, and technology.

Key Areas of Study:

 Geology, Rock Mechanics, Mine Design, Mineral Processing, Safety Engineering, Environmental Impact Assessment, Ventilation Systems, Drilling and Blasting Techniques, Geomechanics, Process Optimization, Remote Sensing, Automation in Mining, Sustainable Mining Practices, Hydraulic Systems, and Mine Health and Safety.

Industries

Mining Engineering plays a pivotal role in industries that are integral to global infrastructure and economic growth. Mining engineers are essential in the extraction of valuable minerals and resources, which are crucial for sectors such as construction, energy, technology, and manufacturing. The mining industry contributes to the production of materials used in everything from electronics and renewable energy systems to heavy machinery and infrastructure development. In addition, mining engineers are at the forefront of sustainable practices, working to reduce environmental impacts through more efficient extraction methods and waste management. The oil and gas industry also relies on mining engineers to ensure the safe and efficient extraction of fossil fuels. With innovations in automation and robotics, mining engineering is also advancing towards safer and more efficient operations. These industries highlight the importance and far-reaching impact of mining engineering in the modern world.

Industries

METALS AND MINERALS

Metals and Minerals engineers focus on the extraction and processing of valuable metals and minerals, such as gold, silver, copper, and iron, which are essential to a wide range of industries. They are responsible for designing efficient extraction methods, improving mineral processing techniques, and ensuring the sustainable and environmentally responsible use of these resources. This career path allows professionals to work on optimizing the entire mining process from resource discovery to final product refinement.

ESSENTIAL SKILLS:

- Mineral extraction techniques
- Metallurgical engineering
- Resource estimation and modeling
- Mineral processing and refining
- Environmental management in mining

POSITIONS:

- Entry Level: Mine Engineer, Junior Metallurgist
- Mid-level: Mineral Processing Specialist, Metallurgical Engineer
- Senior: Senior Mine Engineer, Processing Plant Manager, Resource Estimation Lead

COAL MINING

Coal Mining focuses on the extraction of coal for energy production, a vital resource in global power generation. Mining engineers in this field design safe and efficient excavation techniques, while addressing environmental challenges such as air quality, land reclamation, and water management. The coal mining sector is integral to energy supply but requires a strong focus on sustainability and regulatory compliance to minimize environmental impact.

ESSENTIAL SKILLS:

- Environmental impact assessment
- Safety and hazard management
- Land reclamation and restoration
- Water management and pollution control

POSITIONS:

- Entry Level: Coal Mine Planner, Environmental Compliance
 Assistant
- Mid-level: Mining Safety Specialist, Resource Recovery
 Analyst
- Senior: Senior Coal Mine Planner, Environmental Compliance Officer

OIL SANDS AND PETROLEUM

Oil Sands and Petroleum focuses on the extraction and processing of oil and gas, including challenging resources like oil sands. Engineers in this field work on developing and optimizing methods for extracting bitumen and crude oil, improving refinery processes, and enhancing the environmental sustainability of petroleum extraction. The role requires a deep understanding of thermodynamics, fluid mechanics, and environmental management to balance the demand for energy with the need for reducing the ecological footprint of oil sands operations.

ESSENTIAL SKILLS:

- Oil sands extraction methods
- Petroleum reservoir engineering
- Refining and processing technologies
- Environmental impact management
- Pipeline design and optimization

POSITIONS:

- Entry Level: Petroleum Engineer, Junior Oil Sands Engineer
- Mid-level: Reservoir Engineer, Production Engineer
- Senior: Senior Petroleum Engineer, Oil Sands Operations Manager, Environmental Compliance Officer

CONSTRUCTION MATERIALS

Construction Materials focuses on the development and utilization of materials for building infrastructure such as roads, bridges, and buildings. Engineers in this field work on selecting, testing, and improving materials like concrete, steel, and composites to ensure durability, safety, and cost-efficiency in construction projects. A key challenge is balancing performance with environmental considerations, such as using sustainable materials and minimizing waste.

ESSENTIAL SKILLS:

- Materials testing and analysis
- Concrete and steel design
- Sustainable construction materials
- Construction project management
- Structural integrity assessment

POSITIONS:

- Entry Level: Materials Engineer, Junior Structural Engineer
- Mid-level: Construction Materials Specialist, Project Engineer
- Senior: Senior Materials Engineer, Construction Project
 Manager



Industries

RENEWABLE ENERGY SUPPORT

Renewable Energy Support focuses on providing the technical and operational expertise needed to advance and maintain renewable energy systems such as solar, wind, hydro, and geothermal power. Engineers in this field play a crucial role in improving the efficiency, scalability, and sustainability of renewable energy technologies. They work on system design, energy storage solutions, grid integration, and optimizing renewable resources to reduce reliance on fossil fuels and contribute to a greener, more sustainable future.

ESSENTIAL SKILLS:

- Renewable energy system design
- Energy storage technologies
- · Grid integration and smart grids
- Energy efficiency optimization
- Environmental impact assessments

POSITIONS:

- Entry Level: Renewable Energy Engineer, Energy Analyst
- Mid-level: Wind/Solar Power Engineer, Energy Systems
 Integrator
- Senior: Senior Renewable Energy Consultant, Renewable Energy Project Manager

ENVIRONMENTAL RECLAMATION

Environmental Reclamation focuses on restoring ecosystems and landscapes impacted by industrial activities, particularly mining, oil extraction, and construction. Engineers and specialists in this field design and implement processes to rehabilitate disturbed lands, ensuring that they return to a stable, functional, and sustainable state. This work includes soil remediation, water treatment, and vegetation restoration, with a strong emphasis on minimizing long-term environmental damage and promoting biodiversity.

ESSENTIAL SKILLS:

- Soil and water remediation techniques
- · Environmental impact assessments
- Ecosystem restoration
- Waste management and pollution control
- · Regulatory compliance and environmental laws

POSITIONS:

- Entry Level: Environmental Technician, Reclamation
 Specialist
- Mid-level: Environmental Engineer, Restoration Project Manager
- Senior: Senior Environmental Consultant, Reclamation
 Project Director

AUTOMATION AND DIGITAL MINING

Automation and Digital Mining involves integrating advanced technologies like robotics, artificial intelligence (AI), and data analytics into mining operations to improve efficiency, safety, and decision-making. Engineers in this field focus on automating processes such as excavation, transportation, and mineral processing while utilizing real-time data to optimize operations. The aim is to reduce human error, enhance productivity, and minimize environmental impact through innovative digital solutions and smart mining technologies.

ESSENTIAL SKILLS:

- Robotics and automation systems
- Data analytics and machine learning
- Internet of Things (IoT) integration
- Artificial Intelligence in mining
- Process optimization and predictive maintenance

POSITIONS:

- Entry Level: Automation Engineer, Digital Mining Technician
- Mid-level: AI Mining Specialist, Automation Systems
 Engineer
- Senior: Senior Automation Engineer, Digital Transformation Manager, Smart Mining Consultant

Technical Skills

CORE SKILLS

MINERAL PROCESSING:

Knowledge of extracting valuable minerals from ores using various techniques, including flotation, leaching, and smelting.

MINE DESIGN:

Proficiency in designing safe and efficient mine layouts, considering factors like rock mechanics, ventilation etc.

GEOLOGY:

Understanding the geological characteristics of ore bodies, rock formations, and mineral deposits essential for resource identification and extraction planning.

ROCK MECHANICS:

Expertise in analyzing and predicting the behavior of rocks under stress, crucial for safe excavation and slope stability in mining operations.

VENTILATION SYSTEMS:

Knowledge of designing and maintaining ventilation systems to ensure air quality and safety in underground mines.

SAFETY MANAGEMENT:

Proficiency in identifying potential hazards and implementing safety protocols to protect workers and minimize environmental risks in mining operations.

ENVIRONMENTAL IMPACT ASSESSMENT:

Skills in assessing and managing the environmental effects of mining activities, including waste management, water quality, and land reclamation.

DRILLING AND BLASTING:

Expertise in techniques used to break rock in a controlled manner, ensuring safety and efficiency in resource extraction.

MINING EQUIPMENT MANAGEMENT:

Knowledge of selecting, maintaining, and optimizing mining equipment to enhance operational efficiency.

DATA ANALYSIS AND MODELING:

Proficiency in using data analysis tools and software for resource estimation, mine planning etc.

SOFTWARES AND TOOLS

GEOLOGICAL & MINE PLANNING SOFTWARE:

- Surpac: 3D geological modeling and mine planning.
- Vulcan: Mine design for open-pit and underground operations.
- Datamine: Resource modeling and mine scheduling.

GEOTECHNICAL & ROCK MECHANICS SOFTWARE:

- FLAC3D: 3D geotechnical analysis and rock mechanics.
- RS2: Finite element modeling for geotechnical stability.
- RocScience: Rock mechanics and stability analysis tools.

MINING SIMULATION & PROCESS SOFTWARE:

- XPAC: Mine planning and scheduling.
- Arena: Mining process simulation for operational optimization.

ENVIRONMENTAL & SAFETY SOFTWARE:

- RockWare: Geological data analysis and environmental modeling.
- MineSight: Environmental assessments and resource management.

DATA ANALYSIS & VISUALIZATION:

- ArcGIS: Geospatial mapping for resource management.
- Python (Pandas, NumPy, Matplotlib): Data analysis and visualization.

VERSION CONTROL & COLLABORATION:

- Git/GitHub: Version control for collaborative work.
- Teams/Slack: Communication tools for mining teams.

TESTING & MEASUREMENT:

• LabVIEW: Data acquisition and control systems for mining equipment

How to get Involved

- Engineering Design Teams:
 - https://experience.apsc.ubc.ca/studentgroups/engineering-design-teams-list
- UBC Clubs
- EUS: https://ubcengineers.ca/
- Personal Projects
- UBC Work Learn Program
 - https://ubc-csm.symplicity.com/students/app/home

Other Resources

- Canadian Institute of Mining, Metallurgy, and Petroleum (CIM):
 - <u>http://www.csme-scgm.ca/</u>
- About your degree:
 - <u>https://students.ubc.ca/career/your-</u> degree/engineering/mechanical-engineering