POSTGRADUATE PROGRAMME

Course Structure and Syllabus

(Effective from 2025-26 admitting batch onwards)

DEPARTMENT OF MINING ENGINEERING

Indian Institute of Engineering Science and Technology (IIEST), Shibpur

P.O.: Botanic Garden, District: Howrah

West Bengal – 711 103

Table of Contents

DEPARTMENT OF MINING ENGINEERING AT IIEST SHIBPUR	2
PROGRAMME OBJECTIVES	2
PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)	3
PROGRAMME OUTCOMES (POS)	3
PROGRAMME-SPECIFICOUT COMES (PSOS)	4
COURSE STRUCTURE	5
1ST SEMESTER COURSES SYLLABI	8
2ND SEMESTER COURSES SYLLABI	24
3RD SEMESTER COURSES SYLLABI	38
4TH SEMESTER COURSES SYLLABI	39

DEPARTMENT OF MINING ENGINEERING AT IIEST SHIBPUR

VISION

- To be recognized nationally and internationally as one of the leading institutes in research and providers of quality engineers in the field of Mining Engineering.

MISSION

- To impart quality education and training to undergraduate, postgraduate, and dual B. Tech-M. Tech degree students in Mining Engineering to prepare them for industry, research and higher studies. The department actively encourages excellence in teaching, multidisciplinary research, collaborative activities, and positive contributions to society.

STRATEGY

- The Department, - a pioneer in imparting Mining Engineering education in India, aspires to enhance its diverse and vibrant characteristics encompassing all the sub- disciplines within Mining Engineering and allied fields. Backed by state-of-art laboratories and computational facilities, the students will be inculcated sound fundamental theories in engineering. The department shall enhance the intensity of its interactions with the industries; that will, hopefully, help the students to stay abreast of the latest developments.

PROGRAMME OBJECTIVES

- The M. Tech programme in Mining and Mineral Engineering at the Indian Institute of Engineering Science and Technology (IIEST), Shibpur, is designed to align with the institute's mission of imparting quality education and training to prepare students for industry and higher studies. The programme emphasizes excellence in teaching, multidisciplinary research, collaborative activities, and positive contributions to society.

- The programme is designed to equip students with advanced knowledge, technical skills, and research expertise in mining and mineral processing. The programme aims to develop professionals capable of addressing industry challenges while promoting sustainable and responsible mining practices.

- To align with the National Board of Accreditation (NBA) framework, the M. Tech programme is structured with Programme Educational Objectives (PEOs), Programme Outcomes (POs), and Programme Specific Outcomes (PSOs) that ensure quality education, industry relevance, and sustainability. This structure ensures compliance with NBA accreditation requirements, fostering technical excellence, sustainability, and industry readiness**.**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The M. Tech programme in Mining and Mineral Engineering aims to achieve the following:

PEO1: Technical Proficiency and Advanced Knowledge

- Graduates will acquire advanced knowledge in mining and mineral engineering, including mine planning, rock mechanics, mineral processing, and sustainable mining technologies, enabling them to solve industry challenges.

PEO2: Research and Innovation

- Graduates will engage in research and innovation, contributing to advancements in mineral exploration, extraction, and beneficiation while addressing environmental and economic challenges.

PEO3: Sustainable and Safe Mining Practices

- Graduates will integrate sustainable and safe mining principles, adhering to regulatory standards, environmental conservation, and responsible resource utilization.

PEO4: Leadership and Industry Readiness

- Graduates will demonstrate leadership and managerial skills in mining operations, policy implementation, and project management while staying updated with industry advancements.

PEO5: Lifelong Learning and Ethical Responsibility

- Graduates will pursue lifelong learning through professional development, research, and engagement with industry and academic communities while upholding ethical, social, and environmental responsibilities.

PROGRAMME OUTCOMES (POS)

Graduates of the **M. Tech in Mining and Mineral Engineering** programme will have the ability to:

- Apply advanced knowledge of mining and mineral engineering, mathematics, and allied sciences to solve complex mining problems.
- Identify, formulate, and analyze engineering challenges related to mineral exploration, extraction, and processing, using advanced research techniques.
- Develop innovative and sustainable solutions for mine design, mineral processing, and environmental management.
- Conduct independent research, interpret complex data, and apply modern tools and

methodologies to address emerging issues in mining.

- Utilize state-of-the-art mining software, automation, and digital modeling tools to optimize mineral extraction and processing operations.
- Demonstrate proficiency in mine safety, hazard risk management, environmental impact assessment, and mitigation strategies.
- Uphold professional and ethical responsibilities in mining operations while adhering to national and international mining regulations.
- Apply engineering and management principles to efficiently plan and execute mining projects, ensuring cost-effectiveness and productivity.
- Communicate effectively with engineering professionals, stakeholders, and policy makers through technical reports, presentations, and documentation.
- Recognize the need for continuous learning and professional development to stay abreast of technological and regulatory advancements in the mining sector.

PROGRAMME-SPECIFICOUT COMES (PSOS)

Expected Programme-Specific Outcomes (PSOs) will be reflected in the enhanced ability of the graduates of this programme to:

PSO1: Advanced Mining Technologies and Automation

- Develop and implement modern technologies, including automation, remote sensing, and digital mining solutions, to enhance productivity and safety in mining operations.

PSO2: Sustainable and Responsible Mining

- Apply knowledge of sustainable mining practices, environmental impact assessment, and waste management to promote responsible mineral resource utilization.

PSO3: Research and Innovation in Mineral Processing

Design and optimize mineral beneficiation processes using advanced techniques such as hydrometallurgy, bioleaching, and nanotechnology to enhance resource efficiency.

Course Structure

M. Tech in Mining and Mineral Engineering

COURSE STRUCTURE FOR M. TECH. IN MINING AND MINERAL ENGINEERING										
First Semester										
Sl. No.	**Type**	**Course Name**	**Course code**	**Class Load/Week**			**Credit**	**Class load/ week**	**Marks**
				L	**T**	**P**			
1	PC	Evaluation of Mineral and Energy Resources	MN 5101	3	0	0	3	3	100
2	PC	Engineering Design in Rock	MN 5102	3	0	0	3	3	100
3	PC	Health Safety and Environment	MN 5103	3	0	0	3	3	100
4	PSE	Handling and Transport of Materials Optimization Techniques in Mineral Industries Sustainable Mining Methods	MN 5121 MN5122 MN 5123	3	0	0	3	3	100
5	OE			3	0	0	3	3	100
		Theory Sub-total		**15**	**0**	**0**	**15**	**15**	**500**
6	PC	Engineering Design in Rock Sessional	MN 5171	0	0	3	2	3	50
7	PC	Environmental Lab	MN 5172	0	0	3	2	3	50
8	PC	Mini Project-I	MN 5191	0	0	3	2	3	50
		Practical Sub-total		**0**	**0**	**9**	**6**	**9**	**150**
		First Semester Total		**15**	**0**	**9**	**21**	**24**	**650**
Second Semester										
Sl. No.	**Type**	**Course Name**	**Course code**	**Class Load/Week**			**Credit**	**Class load/ week**	**Marks**
				L	**T**	**P**			
1	PC	Production Planning and Design	MN 5201	3	0	0	3	3	100
2	PC	AI&ML and Data Analytics for Mineral Industries	MN 5202	3	0	0	3	3	100
3	PC	Engineering for Hydrocarbon Resources Extraction	MN 5203	3	0	0	3	3	100
4	PSE	Occupational Ergonomics Project Planning and Management Environmental Pollution Control	MN 5221 MN 5222 MN 5223	3	0	0	3	3	100
5	OE			3	0	0	3	3	100
		Theory Sub-total		**15**	**0**	**0**	**15**	**15**	**500**
6	P	M. Tech. project/Term-paper	MN 5291	0	0	3	2	3	50
7	O	Planning and Design Lab	MN 5271	0	0	3	2	3	50
		Practical Sub-total		**0**	**0**	**6**	**4**	**6**	**100**

		Second Semester Total		**15**	**0**	**6**	**19**	**21**	**600**

Third Semester

Sl. No.	Type	Course Name	Course code	Class Load/Week			Credit	Class load/ week	Marks
				L	T	P			
1	**VAC**			3	0	0	3	3	100
2	P	M. Tech Thesis Part-II (Progress Report)	MN 6191			24	12	24	300
3	O	Progress Report Seminar and Viva-voce	MN 6192				6		100
4	I	Summer internship (6-8 weeks) evaluation	MN 6193				2		50
		Third Semester Total					**23**		**550**

Fourth Semester

Sl. No.	Type	Course Name	Course code	Class Load/Week			Credit	Class load/ week	Marks
				L	T	P			
1	P	M. Tech. Final Thesis	MN 6291				22	30	400
2	O	Thesis Seminar and Viva-voce	MN 6292				8		200
		Fourth Semester Total					**30**		**600**

M. Tech in Mining and Mineral Engineering

Detailed Syllabus

1ST SEMESTER COURSES SYLLABI

M. Tech in Mining and Mineral Engineering

Course Code	MN 5101	Course Name	Evaluation of Mineral and Energy Resources	Course Category	PC	L	T	P
						3	0	0

Pre-requisite Courses	• Basic Geology (Mineralogy, Petrology, Structural Geology) • Mining or Petroleum Engineering (for energy resource evaluation) • Fundamentals of Mathematics and Statistics	Co-requisite Courses	None	Progressive Courses	None
Course Offering Department		Mining Engineering		Data Book / Codes/Standards	None

Course Objectives	This course provides an in-depth understanding of the evaluation and management of mineral and energy resources. It covers the exploration techniques, assessment methods, and sustainable practices in the extraction and utilization of these vital resources.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Introduction to Mineral and Energy Resources:** Definition and types of mineral and energy resources; Significance and role in the global economy and environmental impacts; Historical perspectives and industry trends; Policies and regulations	7	
2	**Review of Geological Fundamentals:** Earth's structure and formation of mineral and energy deposits; Plate tectonics and the distribution of resources; Geological maps and their interpretation; Rock and mineral identification.	7	
3	**Exploration Techniques:** Drilling and sampling techniques; Remote sensing and geophysical methods; GIS and GPS applications in resource exploration; Case studies on exploration projects.	7	
4	**Mineral Resource Assessment:** Reserve and resource classification; Resource estimation methods; Geological modelling; Reporting standards (e.g., JORC, UNFC, NI43-101).	7	
5	**Energy Resource Assessment:** Types of energy resources (fossil fuels, renewables, nuclear); Assessment	7	

	of energy reserves; Energy balance and conversion efficiency.		
6	**Future Trends and Emerging Technologies:** Exploration and extraction in the deep sea and space; Clean energy technologies and the energy transition; Innovations in resource assessment and management; Final projects and presentations	7	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Explain key concepts in mineral and energy resource evaluation, including classification systems (e.g., JORC, UNFC). • Demonstrate knowledge of geological, geophysical, and geochemical exploration methods. • Utilize geostatistical methods (e.g., Kriging, Inverse Distance Weighting) to estimate ore reserves and hydrocarbon resources. • Analyse the economic viability of resource extraction projects, including cost-benefit analysis and risk assessment. • Evaluate the impact of market dynamics, regulations, and sustainability considerations on resource evaluation.

Learning Resources	1. Buchanan D. L. 2015.Metals and Energy Finance: Advanced Text book on the Evaluation of Mineral and Energy Projects. World Scientific Publishing Company. 220 pages 2. Chung C., Fabbri A., and Sinding-Larsen R. 1987. Quantitative analysis of mineral and energy resources. Springer. 738 pages. 3. Kesler S.E., Simon A.C., and Simon A. F. ·2015.Mineral Resources, Economics and the Environment. Cambridge University Press. 434 pages 4. Moon C.J., Whateley M. K. G. and Evans A. M. (ed). 2006. Introduction to Mineral Exploration. Second Edition. Blackwell Publishing. 499p. 5. Pohl, W. L., 2011, Economic Geology: Principles and Practice. Wiley-Blackwell. 663p. Ristinen R. A, and Kraushaar J. J. 2006.Energyandthe Environment. Wiley. 365 pages Rossi M. E. and Deutsch C.V. 2013. Mineral Resource Estimation. Springer.332 pages.

Course Code	MN 5102	**Course Name**	Engineering Design in Rock	**Course Category**	PC	L	T	P
						3	0	0

Pre-requisite Courses	• Engineering Mechanics • Soil and Rock Mechanics • Geotechnical Engineering • Fundamentals of Mining or Civil Engineering	**Co-requisite Courses**	Nil	**Progressive Courses**	Nil
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	Nil

Course Objectives	This course provides an in-depth exploration of the principles and practices of engineering design in rock formations. Topics covered include rock mechanics, geotechnical investigation, design of foundations, slopes, tunnels, and other structures in rock, and the use of modern software tools for analysis and design.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Introduction to Rock Engineering:** Overview of Engineering in Rock; Geological Aspects of Rock Formations; Rock Classification and Properties	4	
2	**Rock Mechanics Fundamentals:** Stress and Strain in Rock; Rock Strength and Failure Criteria; Laboratory Testing of Rock.	4	
3	**Geotechnical Investigation in Rock**: Site Characterization and Geological; Mapping In-situ Testing Techniques; Laboratory Testing for Rock Properties.	5	
4	**Design of Foundations in Rock:** Types of Foundations in Rock; Bearing Capacity and Settlement Analysis; Design of Piles and Caissons.	4	
5	**Slope Stability in Rock:** Types of Slope Failures; Slope Stability Analysis; Mitigation Measures	4	
6	**Tunneling and Underground Excavations in Rock:** Tunneling Methods; Support Systems for Tunnels; Rock Tunnel Design.	4	
7	**Rock Blasting Techniques:** Basics of Explosive Engineering; Drilling and Blasting Methods; Environmental Considerations.	4	
8	**Rock Support and Reinforcement**: Rock Bolts and Mesh; Shotcrete and Grouting; Ground Improvement Techniques.	4	
9	**Rock Engineering Software Tools:** Introduction to GEO-SLOPE, FLAC, and other software; Hands-on exercises and simulations.	5	
10	**Recent Advances in Rock Engineering:** Rock engineering in extreme conditions; Sustainability and environmental concerns; Future trends in rock engineering.	4	

	Total	**42**	

Course Outcome	By the end of this course, students should be able to: •Explain fundamental principles of rock mechanics and their applications in engineering projects. •Assess slope stability, underground excavations, and foundation support systems. •Use computational models and empirical methods for rock engineering analysis. •Design rock reinforcement techniques such as rock bolts, shotcrete, and grouting.

Learning Resources	1. Brady B.H.G. and Brown E. T. Rock Mechanics for Underground Mining 2. Feng X. T. and Hudson J. A. 2011. Rock Engineering Design. CRC Press. 468 pages 3. Hoek E. 2007. Practical Rock Engineering. Downloadable fromhttps://www.rocscience.com/ assets/resources/learning/hoek/Practical-Rock-Engineering-Full-Text.pdf. 341p. 4. Hudson J. A. and Harrison J. P. Engineering Rock Mechanics- An Introduction to Principles. Hustrulid W. A., McCarter M. K., and Van Zyl D. J. A. Slope Stability in Surface Mining. 5. Society for Mining, Metallurgy, and Exploration, USA. 442P. 6. Palmstrom A. and Stille H. 2015. Rock engineering, 2nd edition. ICE Publishing, 444 pages. 7. Pariseau W. G. 2011. Design Analysis in Rock Mechanics, SecondEdition.CRCPress.698 pages 8. Wood A. M. 2000. Tunneling: Management by Design. CRC Press. 328pages 9. Wyllie D. C. and Mah C. W 2005. Rock Slope Engineering,4th Edition, CRC Press. 456 pages. Additional readings and research articles as provided by the instructor

Course Code	MN 5103	**Course Name**	Health, Safety, and Environment	**Course Category**	PC	L	T	P
						3	0	0

Pre-requisite Courses	1. Basic Mining Engineering or Geology 2. Occupational Health and Safety Principles (optional but useful) 3. Engineering Mathematics **4.** Probability and Statistics	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course provides a comprehensive understanding of the principles and practices of health, safety, and environmental management in mining. Topics include safety regulations, risk assessment, emergency response, environmental impact assessment, and sustainable mining practices.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Basic Mathematics and Rudiments of Safety Engineering:** Review of Engineering Mathematics and Statistics; Safety and Engineers, Statute, Administrative, Common, and Liability Laws; Accident Causation Theories, Common Causes of Work Injuries; Accident Death Rates by Industry; Workmen's Compensation.	8	
2	**Accident Investigation and Reporting:** Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee – cost of accident.	6	
3	**Safety Management:** Safety Management Principles and Safety Department Functions; Safety Manager's and Engineer's Functions; Developing a Safety Programme Plan and Safety-related Strategies for Safety Professionals; Motivating Workers to Work Safely and Management-related Deficiencies Leading to Accidents; Safety-related Responsibilities of Non-safety Groups; Safety Checklist for Management; Safety Cost Estimation Model; The Heinrich Method; The Simonds Method.	8	
4	**Human Behavioural Approach in Safety:** The Need for the Application of Human Factors; Occupational Stressors and Human Factors-related Formulas; Human Factors Safety Issues; Classifications and Causes of Human Errors Resulting in Fatalities; Methods for Performing Human Error Analysis in the Area of Mine Safety.	5	
5	**Safety Analysis Methods, Indices and Mathematical Models:** Safety Analysis Methods and Indices: Hazards and Operability (HAZOP); Job Safety Analysis (JSA); Preliminary Hazard Analysis (PHA); Failure Mode and Effective; Analysis, Interface Safety Analysis; (ISA), Fault Tree Analysis; Markov Method; Mathematical Models for Performing Safety Analysis in Mines.	8	
6	**Safety Audits and Control:** Components of safety audit, types of audit, audit methodology, audit checklist and report–review of inspection, remarks by government agencies, identification of unsafe acts of workers and unsafe conditions, method of promoting safe practice - motivation – communication - role of government agencies	7	

	and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.		
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Identify and analyse common mining hazards. • Use methods such as 'Hazard Identification and Risk Assessment' and 'Job Safety Analysis' to evaluate risks. • Develop and apply safety protocols, emergency response plans, and risk mitigation strategies. • Interpret and apply local and international mining safety laws and compliance standards. • Address issues like noise, vibration, heat stress, and musculoskeletal disorders in mine workers.

Learning Resources	1. Å strand P-O.2003.TextbookofWork Physiology: Physiological Bases of Exercise. Human Kinetics. 649 pages 2. Bridger R. S. 2008. Introduction to Ergonomics, Third Edition. CRC Press. 808 pages Corlette. N. and Clark T. S. 2003. The Ergonomics of Workspaces and Machines: A Design 3. Manual. CRC Press, 144 pages 4. Dhillon B. S. 2010. Mine Safety: A Modern Approach. Springer. 186 pages. 5. Ericson II C. A. 2005. Hazard Analysis Techniques for System Safety. Wiley-Inter science. 6. 528 pages 7. Friend M. A. and Kohn J. P. 2014. Fundamentals of Occupational Safety and Health. Bernan Press, 556 pages. 8. Roland H. E. and Moriarty B. 1990. System Safety Engineering and Management. 2nd Edition. Wiley-Inter science. 384 pages. 9. Shrawan Kumar 2007. Biomechanics in Ergonomics, Second Edition. CRC Press.744 pages Slote L. 1987. Handbook of Occupational Safety and Health. Wiley. 744 pages 10. Strauch B. 2004. Investigating Human Error: Incidents, Accidents, and Complex Systems. Ashgate Pub Ltd; 324 pages.

Course Code	MN 5121	**Course Name**	Handling and Transport of Materials	**Course Category**	PSE	L	T	P
						3	0	0

Pre-requisite Courses	• Basic Mining Engineering or	**Co-requisite Courses**	None	**Progressive Courses**	None

	Geology • Basic Mechanical Engineering Principles • Theory of Machines				
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course provides a comprehensive understanding of material handling and transport systems in mining operations. Topics include equipment selection, system design, safety measures, and optimization strategies for efficient material movement in mining.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Principles of Materials Handling:** Principles relating to Planning, Systems, Material Flow, Simplification, Gravity, Space Utilization, Unit Size, Safety, Mechanization, Equipment Selection, Standardization; Flexibility, Dead-Weight, Motion, Idle Time; Maintenance, Obsolescence, Control, Capacity, and Performance.	5	
2	**Unit Load Concept:** Definition; Advantages and Disadvantages; Load Unitization Process and Handling Methods; Pallets, Skids and Containers; Alternative Methods of Handling.	5	
3	**Classification of Materials Handling Equipment:** Basic Equipment Types; Classification of Handling Equipment.	4	
4	**Off-Highway Trucks:** General Applicability; Descriptions, Drive Components; Brakes, Tyres, Dump Bodies, Specifications, Special Equipment; Performance: Horsepower Utilization, Retarding, Gradeability; Trolley Assist, Automatic Truck Control; Truck Cycle Time; - Spot and Load, Travel, Turn and Dump; Delays, Total Cycle Time; Production and Fleet Requirements, - Matching Trucks and Loading Equipment; Availability and Utilization, Production, Truck Requirements.	6	
5	**Conveyors:** Belt Conveyors; Chain Conveyors; Haulage Conveyors; Cable Conveyors; Bucket Conveyors; Roller Conveyors; Screw Conveyors; Pneumatic Conveyors; Design and Selection of Conveyor-Belt.	5	
6	**Hoisting Equipment:** Parts of Hoisting Equipment; Hoists, Winches, Elevators, Cranes, Derricks.	5	
7	**Bulk Handling Equipment and Systems:** Storage of Bulk Solids; Bulk Handling Equipment.	4	
8	**Auxiliary Equipment:** Gates; Feeders; Chutes; Positioners; Ball Tables; Weighing and Control Equipment; Pallet Loader and Unloader.	5	

9	**Organisation, Maintenance and Safety:** Organisation, Maintenance, Safety in Materials Handling.	3	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Explain the fundamental principles, types, and significance of material handling in industries. • Analyze Handling and Transport Systems and evaluate different types of handling equipment. • Design and improve material handling layouts for efficient storage, retrieval, and movement. • Choose the right material handling systems based on factors like load type, distance, cost, and efficiency. • Use Automation and Smart Handling Systems.

Learning Resources	1. Arora K. C. and Shinde V. V. 2007. Aspects of Materials Handling. FirewallMedia.327 pages 2. Conveyor Equipment Manufacturers Association. 2007. Belt Conveyors for Bulk Materials. 3. Conveyor Equipment Manufacturers Association.600 pages 4. Mulcahy D. E. 1999. Materials Handling Handbook.McGraw-Hill,768 pages 5. Ray T. K. 2005. Mechanical Handling of Materials. Asian Books Private Limited. 245 pages Wolhbier R. H.(ed). 1986. Hydraulic Conveying and Slurry Pipeline Technology. Trans. Tech Publication. 232pages 6. Woodcock C. R. and Mason J. S. 2013. Bulk Solids Handling: An Introduction to the Practice and Technology, Springer Science and Business Media. 522 pages.

Course Code	MN 5122	**Course Name**	Optimization Techniques in Mineral Industries	**Course Category**	PSE	L	T	P
						3	0	0

Pre-requisite Courses	• Introductory Mining Engineering or Geology • Basic Mathematics and Statistics	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course provides a comprehensive understanding of optimization methods and their application in solving complex problems in the mineral and mining industries. Topics include linear programming, integer programming, network optimization, nonlinear programming, and their use in optimizing mining operations, resource estimation, and sustainable mineral extraction.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Introduction to Optimization in Mineral Industries:** Overview of Optimization and its Importance; Optimization Problems in Mining; Types of Optimization Techniques.	4	
2	**Linear Programming (LP) in Mining:** Basics of LP; LP Formulation in Mining Problems; Geometric Interpretation of LP.	4	
3	**LP Applications in Mining:** Blending and Production Optimization; Transportation and Logistics Optimization; Case Studies in LP.	4	
4	**Integer Programming (IP) and Mixed-Integer Programming (MIP) in Mining:** Basics of IP and MIP; Resource Allocation and Scheduling in Mining; Solving IP and MIP Problems.	4	
5	**Network Optimization in Mining:** Flow Networks in Mining; Shortest Path and Maximum Flow Problems; Network Design and Layout.	4	
6	**Nonlinear Programming (NLP) in Mining:** Flow Basics of NLP; Nonlinear Regression and Optimization; Case Studies in NLP.	4	
7	**Stochastic Optimization in Mining:** Uncertainty and Risk Analysis in Mining; Stochastic Programming and Decision-Making; Monte Carlo Simulation in Mining.	4	
8	**Multi-objective Optimization in Mining:** Dealing with Multiple Conflicting Objectives; Pareto Front and Decision-Making; Applications in Sustainability and Resource Management.	4	
9	**Software Tools for Optimization in Mining:** Introduction to software tools like GAMS, AMPL, or specific mining software; Hands-on exercises and simulations.	4	
10	**Case Studies in Optimization in Mineral Industries:** Real-world mining projects and case studies; Student project presentations.	3	
11	**Emerging Trends in Optimization in Mineral Industries:** Big Data and Optimization; Automation and Robotics in Mining; Future Challenges and Opportunities.	3	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: ● Explain the role of optimization in decision-making for mineral industries. ● Utilize linear programming, nonlinear programming, and integer programming for mining operations. ● Apply economic optimization techniques to maximize revenue and minimize costs in mineral extraction and processing. ● Implement simulation-based and heuristic approaches like genetic algorithms and Monte Carlo simulations. ● Optimize material transport, supply chain, and distribution networks in the mining sector.

Learning Resources	1. Gilett B. E. 1979. Introduction to Operations Research: A Computer-Oriented Algorithmic Approach, Tata McGraw-Hill. 631p. 2. Gorai A. K. and Chatterjee S. 2022. Optimization Techniques and their Applications to Mine Systems. CRC Press. 404p. 3. Hillier F.and Lieberman G. 2021. Introduction to Operations Research, 11th Edition. 4. McGraw Hill. 992 pages 5. Kumar P., Hira D. S. and Gupta K. A. 2014. Introduction to Operations Research. S. Chand and Sons.229 pages. 6. Rao S. S.1984. Optimisation Theory and Applications. Halsted Press. 747 pages. 7. Swarup K., Gupta P. K., Mohan M. 2022. Operations Research: Introduction to Management Science. xxiv + 1,160 pages. 8. Taha H. H. 2017. Operations Research: An Introduction (10th Edition) 9. Weintraub A., Romero C., Bjørndal T. and Epstein R. 2007. Handbook of Operations Research in Natural Resources. (Volume 99 of International Series in Operations Research and Management Science). Springer Science and Business Media. 624 pages 10. Winston W. L. 2022. Operations Research: Applications and Algorithms. Cengage Learning. 11. 1440 pages 12. Yang Xin-She. 2018. Optimization Techniques and Applications with Examples. Wiley.384 pages Additional readings and research articles as provided by the instructor

Course Code	MN 5123	**Course Name**	Sustainable Mining Methods	**Course Category**	PSE	L	T	P
						3	0	0

Pre-requisite Courses	None	**Co-requisite Courses**	None	**Progressive Courses**	None

Course Offering Department	Mining Engineering	Data Book / Codes/Standards	None

Course Objectives	This course explores the biological processes used in mining and mineral recovery, with an emphasis on bioleaching and bioremediation. It covers the fundamental microbiological principles, industrial applications, and emerging technologies in biomining. The course integrates theoretical concepts with practical applications in mining operations and environmental sustainability.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Introduction to Bio-mining:** Definition and significance of biomining; Comparison with conventional mining and metallurgical techniques; Historical development and industrial adoption of biomining; Advantages and limitations of biomining.	4	
2	**Microbial Diversity in Bio-mining:** Types of microorganisms used in biomining; Acidophilic bacteria: Acidithiobacillus ferrooxidans, Leptospirillum spp.; Fungi and archaea in bio-mining; Role of extremophiles in metal extraction; Microbial metabolism and energy generation in biomining; Genetic engineering and synthetic biology approaches in biomining.	5	
3	**Bioleaching Mechanisms:** Direct vs. indirect bioleaching; Microbial oxidation of sulfide minerals; Metal recovery mechanisms from ores and concentrates; Factors affecting bioleaching efficiency (pH, temperature, redox potential); Case studies: Copper, uranium, and zinc bioleaching.	6	
4	**Industrial Applications of Biomining:** Heap bioleaching vs. tank bioleaching vs. in-situ bioleaching; Biomining of base metals: Copper, nickel, zinc; Biomining of precious metals: Gold and silver bio-oxidation; Uranium biomining: Microbial recovery of radioactive elements; Commercial biomining operations: Case studies from Chile, South Africa, and Australia.	5	
5	**Bioremediation and Waste Management:** Bioremediation of mining waste and tailings; Microbial treatment of acid mine drainage (AMD); Heavy metal detoxification using bacteria and fungi; Bio-sorption and bioaccumulation techniques; Case studies of bioremediation in abandoned mines.	5	
6	**Environmental and Economic Aspects of Biomining:** Environmental benefits of biomining over traditional mining methods Carbon footprint and sustainability of biomining processes; Cost analysis and economic feasibility of biomining operations; Ethical considerations and social impact of biomining projects.	6	
7	**Emerging Trends and Future Perspectives:** Nano-biotechnology in bio-mining; CRISPR and genetic	6	

	modification of bio-mining microbes; Space bio-mining: Microbial metal extraction on asteroids and Mars; AI and machine learning in bio-mining process optimization; Future challenges and potential of bio-mining.		
8	**Case Studies and Industrial Visits:** Review of major bio-mining projects globally; Industrial visit to a bio-mining facility or guest lecture by industry experts; Group projects on designing a bio-mining solution for specific ore deposit.	5	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Explain the principles of bioleaching and bio-oxidation in mineral processing. • Analyse the Bioleaching Process in metal dissolution from sulphide ores and tailings. • Evaluate the use of bioleaching in extracting metals like copper, gold, uranium, and rare earth elements. • Compare bio-mining with conventional mining techniques interms of sustainability and cost-effectiveness. • Utilize spectroscopic, electrochemical, and microbial analysis techniques for bioleaching monitoring.

Learning Resources	1. Amils R. and Ballester A. 1999. Bio-hydrometallurgy and the Environment Toward the Mining of the 21stCentury. Proceedings of the International Biohydrometallurgy Symposium (IBS'99). 20-23 June1999•SanLorenzo de El Escorial, Madrid, Spain. 842 pages. 2. Donati E. R. and Sand W. 2007. Microbial Processing of Metal Sulfides. Springer 3. Johnson D. B. and Bryan C. G. Biomining Technologies: Extracting and Recovering Metals from Ores and Wastes 4. Pathak P. and Palani S, G. 2022. Circular Economy in Municipal Solid Waste Land filling: Biomining and Leachate Treatment: Sustainable Solid Waste Management: Waste to Wealth. 453 pages. 5. Rawlings D. E. and Johnson D. B. 1997. Biomining. Springer. 333p. Roberto C. and Tributsch H. "Bio-hydrometallurgy and the Environment" Bohumil Volesky. “Sorption and Biosorption”

Course Code	MN 5171	**Course Name**	Engineering Design in Rock Sessional	**Course Category**	PSE	L	T	P
						0	0	3

Pre-requisite Courses	Fundamental of Rock Mechanics	**Co-requisite Courses**	None	**Progressive Courses**	None

Course Offering Department	Mining Engineering	Data Book / Codes/Standards	None

Course Objectives	To be familiar with the state-of-the-art softwares used predominantly used in the academic as well as industry to deal with geotechnical investigation, design of foundations, slopes, tunnels, and other structures in rock for analysis and design such as RS3, Slide, Dip, RS pile, SDPS, FLAC etc.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**RS3:** Conceptualizations and handling of the software to solve and understand the strata behaviour in proposed underground mining excavations.	8	
2	**Slide:** Conceptualizations and handling of the software to solve and understand the slope behaviour in proposed opencast mining workings.	7	
3	**Dip:** Conceptualizations and handling of the software to solve and understand the discontinuities in layers in mining excavations.	6	
4	**RS pile:** Conceptualizations and handling of the software to solve and understand the stability of different structures created to facilitate the mining operations.	6	
5	**SDPS:** Conceptualizations and handling of the software to solve and understand the surface profile changes as well as subsidence behaviour due to mining operations.	6	
6	**FLAC:** Conceptualizations and handling of the software to solve and understand the different behavioral pattern of the strata to due to different design related to the mining operations.	9	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Understand and explain the strata behaviour in proposed underground mining excavations. • Design of foundations, slopes, tunnels, and other structures in rock for analysis and design such as RS3, Slide, Dip, RS pile, SDPS, FLAC etc.

Learning Resources	1. RocScience manual. 2. FLAC manual of ITASCA, Canada 3. Brady B.H.G. and Brown E. T. Rock Mechanics for Underground Mining 4. Hoek E. 2007. Practical Rock Engineering. 5. Hudson J. A. and Harrison J. P. Engineering Rock Mechanics- An Introduction to Principles.

Course Code	MN 5172	Course Name	Environmental Lab	Course Category	PSE	L	T	P
						0	0	3

Pre-requisite Courses	None	Co-requisite Courses	None	Progressive Courses	None
Course Offering Department		Mining Engineering		Data Book / Codes/Standards	None

Course Objectives	This course explores the biological processes used in mining and mineral recovery, with an emphasis on bioleaching and bioremediation. It covers the fundamental microbiological principles, industrial applications, and emerging technologies in biomining. The course integrates theoretical concepts with practical applications in mining operations and environmental sustainability.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	Sampling and analysis of Suspended Particulate Matter (SPM), PM10, and PM2.5 using High Volume Sampler	9	
2	Estimation of gaseous pollutants: SO_2 and NOx using gas sampling and analysis kits	6	
3	Measurement of ambient and occupational noise levels using a Sound Level Meter.	6	
4	Mine Wastewater parameters: Determination of Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD), pH, turbidity, TDS, hardness, chloride, sulphate.	12	
5	Acid Base Accounting for determining Acid Mine Drainage Potential studies	9	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Carry out air, water, soil, and noise quality assessments in and around mining areas. • Use and calibrate modern environmental monitoring equipment effectively. • Analyze environmental samples and interpret data in compliance with regulatory standards. • Demonstrate understanding of environmental impact and pollution control measures in mining. • Prepare technical reports and documentation related to environmental monitoring and management.

Learning Resources	1. Lottermoser B. G. 2003. Mine Wastes: Characterization, Treatment, and Environmental Impacts. Springer.277 p. 2. Mahajan, S.P. 1985. Pollution Control in Process Industries, Tata McGraw-Hill. 273p. 3. Peavy, H.S., Rowe, D.R., and Tchobanoglous, G. – Environmental Engineering, McGraw-Hill. 736p 4. Relevant CPCB, SPCB, and MoEFCC Guidelines for air, water, and noise quality standards. 5. Laboratory manuals and user guides for environmental monitoring instruments.

Course Code	MN 5191	**Course Name**	Mini Project-I	**Course Category**	PSE	L	T	P
						0	0	3

Pre-requisite Courses	• Graduate-level course work in the relevant field • Basic research methodology knowledge	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course marks the initiation of defining the mining problems, conducting literature review, and formulating a research methodology. Students will prepare a report paper summarizing the background, objectives, and proposed approach for their research.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Defining the mining problems:** Identify a mining problem relevant to their field of study	8	
2	**Conducting literature review: L**iterature review and establish the research gap.	14	
3	**Formulating a research methodology:** Formulating a research proposal outlining objectives and methodologies.	10	
4	**Preparation of a report:** Prepare a report paper summarizing the background, objectives, and proposed approach for their research	10	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Identify a mining problem relevant to their field of study. • Identify the research gap.

	• Outlining objectives and methodologies. • Report paper that forms the basis for further research.

Learning Resources	1. Allison B. and Race P. 2015. The Student's Guideto Preparing Dissertations and Theses. 2. Routledge.112pages 3. Raveendran R., Gitanjali B. and Manikandan S, 2014. A Practical Approach to PG Dissertation: A Handbook of Research Methodology for Postgraduate Students. BSP Books Pvt. Ltd. 316 pages. 4. Terrell S. R. 2022. Writing a Proposal for Your Dissertation, Second Edition. Guilford Press. 5. 320 Pages. 6. Thomas D. R. and Hodges I. D. 2010. Designing and managing your research project: core skills for social and health research Responsibility. Los Angeles: SAGE. vii, 253 p.

2ND SEMESTER COURSES SYLLABI

M. Tech in Mining and Mineral Engineering

Course Code	MN 5201	**Course Name**	Production Planning and Design	**Course Category**	PC	L	T	P
						3	0	0

Pre-requisite Courses	• Mining Methods • Geology of Ore Deposits • Rock Mechanics and Ground Control • Mine and Mineral Economics	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course provides a comprehensive understanding of the principles and practices of mine planning and design. Topics covered include mining methods, geological considerations, mine safety, environ-mental regulations, equipment selection, and the use of software tools for mine planning and design.

Module	**Syllabus**	**Duration (class-hour)**	**Module Outcome**
1	**Systems Approach:** Systems Concept; Systems approach to Mine Planning and Design. Underground Mine Planning	4	
2	**Mining Method Selection:** Evaluation of Mining Methods and Systems; Mining Methods Classification System**;** Selection Process for Hard-Rock Mining; Selection Process for Underground Soft-Rock Mining; Comparison of Underground Mining Methods; Comparison of Surface Mining Methods	10	
3	**Planning Infrastructure and Services:** Electric Power Distribution and Utilization; Compressed Air; Mine Communications, Monitoring, and Control; Dewatering Surface Operations; Dewatering Underground Operations; Physical Asset Management; Mine Infrastructure Maintenance.	9	
4	**Development Planning for Underground Mines:** Hard-Rock Equipment Selection and Sizing Soft-Rock Equipment Selection and Sizing; Underground Horizontal and Inclined Development Methods; Subsurface Mine Development; Construction of Underground Openings and	10	

	Related Infrastructure; Underground Ore Movement; Hoisting Systems.		
5	**Environmental Issues:** Site Environmental Considerations; Waste Disposal and Contamination Management, - tailings impoundments and dams; waste piles and dumps; Closure Planning: Management of the Social Impacts of Mining.	9	
	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Explain the stages of mine planning, from exploration to closure. • Assess geological, geotechnical, and economic factors influencing mine layout. • Develop optimal pit and underground layouts based on ore body geometry and extraction methods. • Optimize short-term and long-term production schedules using modern software tools. • Determine appropriate machinery, haul roads, ventilation systems, and material handling facilities. • Perform financial modeling, cost analysis, and risk assessment for mining projects.

Learning Resources	1. Bhattacharya J. (2003): Principles of Mine Planning, 2nd Edition. Allied Publishers Pvt Ltd., New Delhi. 508 pages 2. Darling P (ed.) (2011): SME Mining Engineering Handbook, Third Edition. Two Volume Set. Society for Mining, Metallurgy, and Exploration Inc. Littleton, CO, USA. 1984pages 3. Hustrulid W. A., Kuchta M. and Martin R. K. (2013): Open Pit Mine Planning and Design, Two Volume Set and CD-ROM Pack, Third Edition. CRC Press. 1308 pages 4. Mathur S. P. (1993): Mine Planning for Coal. M. G. Consultants, Bilaspur. 295 pages Popov G.and Shiffer V. 2001. The Working of Mineral Deposits. University Press of the 5. Pacific.620pages 6. Shevyakov, L. (1965): Mining of Mineral Deposits, Foreign Languages Publishing House, Moscow. 7. Vorobjev B. M. and Desmukh R. T. (1966): Advanced Coal Mining, Two Volume Set, Asia Publishing House, Calcutta. Additional readings and research articles as provided by the instructor

Sl No. TOPIC **Lecture**

Course Code	MN 5202	**Course Name**	AI&ML and Data Analytics for Mineral Industries	**Course Category**	PC	L	T	P
						3	0	0

Pre-requisite Courses	• Introductory Mining Engineering • Basic Geology	**Co-requisite Courses**	None	**Progressive Courses**	None		

	• Basic Statistics and Probability				
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course explores the use of data analytics, statistical techniques, and data-driven decision-making in the mineral and mining industries. Topics include data collection, analysis, modeling, and their applications in optimizing mining operations, resource estimation, and sustainable mineral extraction.

Module	Syllabus	Duration (class-hour)	Module Outcome
Structural Dynamics			
1	**Introduction to Analytics in Mineral Industries:** Overview of Analytics and its Importance Data-Driven Decision Making in Mining; Types of Data in the Mineral Industry.	4	
2	**Data Collection and Management:** Data Sources in Mining; Data Collection Techniques; Data Cleaning and Pre-processing.	4	
3	**Exploratory Data Analysis (EDA):** Descriptive Statistics; Data Visualization in Mining; Identifying Patterns and Trends.	4	
4	**Statistical Techniques for Mineral Analysis:** Hypothesis Testing in Mining; Regression Analysis in Resource Estimation; Confidence Intervals and Prediction Intervals.	4	
5	**Time Series Analysis in Mining:** Time Series Data in Mining; Forecasting Production and Price Trends; Case Studies in Time Series Analysis	4	
6	**Machine Learning in Mining:** Introduction to Machine Learning; Supervised and Unsupervised Learning; Applications in Mineral Exploration and Optimization.	5	
7	**Spatial Analysis and GIS in Mining:** Geostatistics and Spatial Analysis; Kriging and Variogram Analysis; GIS Applications in Mining.	4	
8	**Data-Driven Decision Making in Mining Operations:** Optimization in Mining; Maintenance and Reliability Analytics; Risk Management.	4	
9	**Software Tools for Analytics in Mining:** Introduction to software tools like R, Python, or specific mining; software Hands-on exercises and simulations.	5	
10	**Emerging Trends in Analytics in Mineral Industries:** Block chain and Supply Chain Analytics; Automation and Robotics in Mining; Future Challenges and Opportunities.	4	

	Total	**42**	

Course Outcome	By the end of this course, students should be able to: • Explain how data analytics is applied in the exploration, extraction, and processing of minerals. • Utilize machine learning and predictive models to forecast mineral resource potential, ore quality, and location. • Apply analytics to optimize mining operations, including scheduling, production efficiency, and resource allocation. • Develop data-driven strategies for operational improvements, risk management, and cost reduction. • Utilize Big Data and IoT in Mining

Learning Resources	1. Damnjanovic I. and Reinschmidt K. 2019. Data Analytics for Engineering and Construction Project Risk Management. Springer International Publishing. 379p. 2. RabeloL., Gutierrez-Franco E, Sarmiento A, and Mejía-Arguet C. 2022. Engineering Analytics: Advances in Research and Applications. CRC Press. 282 Pages. 3. Sankaran S., Matringe S. and Sidahmed Md. 2020. Data Analytics in Reservoir Engineering. 4. Society of Petroleum Engineers.108p. Additional readings and research articles as provided by the instructor

Course Code	MN 5203	**Course Name**	Engineering for Hydrocarbon Resources Extraction	**Course Category**	PC	L	T	P
						3	0	0

Pre-requisite Courses	• Introduction to Geology or Earth Sciences • Basic knowledge of Chemistry and Physics	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course provides a comprehensive understanding of the principles and practices involved in the extraction of hydrocarbon resources, including oil and natural gas. Topics include exploration, drilling techniques, production methods, reservoir engineering, environmental considerations, safety in the oil and gas industry, and emerging trends.

Module	**Syllabus**	**Duration (class-hour)**	**Module Outcome**

1	**Petroleum Geology and Exploration Methods:** Hydrocarbon Reservoirs; Structural Geology and Traps; Petroleum Exploration Methods.	3	
2	**Drilling Operations and Formation Evaluation:** Drilling rigs and casing system; Different types of wells; Well completion and formation evaluation.	3	
3	**Well logging:** Different types of well logging system.	3	
4	**Production Methods:** Primary, Secondary, and Tertiary Recovery; Artificial Lift Systems; Enhanced Oil Recovery (EOR) Techniques.	3	
5	**Reservoir Engineering and Fluid Flow Analysis:** Reservoir Rock and Fluid Properties; Reservoir Pressure and Flow Behavior; Material Balance and Reservoir Performance; Decline Curve Analysis.	6	
6	**Unconventional Hydrocarbon Resources:** CBM, Shale Gas and Oil Extraction; Oil Sands and Heavy Oil Extraction; Emerging Technologies in Unconventional Resources.	4	
7	**Wellbore Stability and Drilling Challenges:** Wellbore Stability Issues; Mud Weight Selection; Wellbore Failure Mechanisms.	3	
8	**Hydraulic Fracturing and Fracture Mechanics:** Principles of Hydraulic Fracturing; Fracture Mechanics in Reservoirs; Fracture Propagation and Interaction.	4	
9	**Reservoir Compaction and Subsidence:** Compaction and Depletion of Reservoirs; Subsidence Effects and Management; Case Studies on Reservoir Compaction	3	
10	**Geo-mechanical Modeling in Reservoir Simulation:** Coupling Geomechanics with Reservoir Simulation; Stress-Dependent Permeability; Predictive Modeling.	4	
11	**Faults and Fractures in Reservoirs:** Fault Behaviour and Impacts on Reservoirs; Fracture Networks and Connectivity; Reservoir-Geomechanics Interactions.	3	
12	**Geomechanics and Enhanced Oil Recovery (EOR):** EOR Techniques and Geomechanical Considerations; Hydraulic Fracturing for EOR; CO_2 Sequestration and Geomechanics.	3	
	Total	**42**	

Learning Resources	1. Ahmed T. 2010. Reservoir Engineering Handbook 2. Banerjee A. 2010. Hydrocarbon Exploration and Production Technology Handbook 3. Barati R. and Alhubail M M. 2020. Unconventional Hydrocarbon Resources: Techniques for Reservoir Engineering Analysis. Wiley. 608 Pages 4. Economides M J. and Economides K J. 2000. Petroleum Well Construction 5. Elsharkawy A. T. 2013. Petroleum Engineering: Principles, Calculations, and Applications. Gary J H. and Smith R P. 2000. Oil Shale: A Resource for the Future. 6. Holditch S and Elsharkawy A T .2018. Petroleum Production Engineering: Practices, Technology, and Economics. 7. Jennings, Jr. P E. 2015. Hydrocarbon Reservoir Characterization Katz D. L. and

	Katz R. L. 2006. Natural Gas Engineering Handbook. 8. Russell D. G. and Perry R. V. 2010. Fundamentals of Petroleum and Natural Gas Engineering. 9. Speight J G. 2019. Handbook of Industrial Hydrocarbon Processes. 2nd Edition. Elsevier. 10. Zoback M D. 2007. Reservoir Geomechanics

Course Code	MN 5221	**Course Name**	Occupational Ergonomics	**Course Category**	PSE	L	T	P
						3	0	0

Pre-requisite Courses	• Introductory Ergonomics • Introductory Physiology • Basic knowledge on Physical Ergonomics	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	Occupational ergonomics is a critical aspect of workplace safety and productivity in mineral industries. This course provides an in-depth understanding of ergonomic principles, human factors engineering, and their applications in mining and mineral processing operations. It covers the assessment and design of work environments to enhance worker efficiency, reduce fatigue, and prevent musculoskeletal disorders. Students will explore topics such as biomechanics, work-related stressors, manual material handling, vibration exposure, work posture analysis, and ergonomic intervention strategies. The course integrates case studies, industry standards, and best practices to help learners develop skills in hazard identification and workplace design improvements. By the end of the course, students will be equipped to evaluate and implement ergonomic solutions tailored to the unique challenges of mineral industries, ultimately improving worker safety, comfort, and operational efficiency.

Module	**Syllabus**	**Duration (class-hour)**	**Module Outcome**
1	**Ergonomics:** Concept of Ergonomics, history of Ergonomics, it's development in European countries and USA; Type of Ergonomics- Physical Ergonomics. Stressors: Physical, Physiological and Environmental; Type and classification of stressors, workplace stressors; Effect of stress; Physiological stressors and stress parameters; Concept of cardiovascular load; Continuous and intermittent job. Concept of LCW; Determination of Workload; Astrand classification; NIOSH-OSHA-ACGIH guidelines and classification of different workload/type of	9	

	job; different index. Overview of ergonomic principle industrial application; Circadian rhythm and shift work.		
2	**Ergonomic Principle and Computational Method:** Determination of workload, Rest-pause scheduling-SPITZER model; Determination of cardiac stress-NCC; RCC and HRR; Concept of physical exertion; BORG sealing; NASA Task load index; Physical and metabolic rate; Work performance and efficiency; Factor effecting work performance and efficiency; Cardiac-respiratory factors; Concept of RAS and aerobic capacity, Workplace dust exposure and lung diseases-Remedial measures.	9	
3	**Physical Ergonomics in machine design:** Concept of body somatotyping; Body alignment and bone structure; Different anthropometric dimension; Hand coupling; Concept of seat and cabin design of machinery; BIFMA guideline; Indian anthropometric dimension; Concept of percentile dimension; Man-machine interface-actors involved in good man-machine interfaces; Concept of ZCR.	8	
4	**Positive and Human Biomechanics:** Definition of good posture; Concept of human center of gravity; Anatomy of spinal cord; Posture analysis method- REBA; RULA; OWAS; Concept of RSI; Repetitive work and posture-Measurement method ORCA; Force exertion; Human Biomechanics-Determination of back compression force-University of Urah; MMH-NIOSH Lifting equation; Muscle Fatigue-Factors involved in muscle fatigue; Work related MSDs.	8	
5	**Noise and Vibration:** Noise induced hearing loss; Noise level measurement; Noise controlling approaches in workplace; Measurement of vibration; Vibration analysis; Dose value; time weighted RMS; TLV and caution zone value-ISO and ACGIH standard; whole body tri-axial analysis; Whole vibration analysis- ISO and ACGIH standard. **Application of Software** **Cause studies.**	8	
	Total	**42**	

Course Outcome	This course equips students with the knowledge and skills to design safer, healthier, and more productive work environments in the mineral industry. Upon successful completion of this course, students will be able to: ● Explain Ergonomic Principles–Explain the fundamental concepts of occupational ergonomics and their significance in mineral industries. ● Assess Workplace Ergonomic Risks–Identify and evaluate ergonomic hazards associated with mining and mineral processing operations. ● Analyze Work-Related Musculoskeletal Disorders (WMSDs) – Examine the

	causes, effects, and prevention strategies for WMSDs among workers in mineral industries. ● Optimize Work Environment Design –Apply ergonomic principles to improve workplace layout, tools, and equipment design to enhance worker safety and efficiency. ● Evaluate Human-Machine Interaction – Assess the impact of equipment design, vibration exposure, and manual material handling on worker performance and health. ● Implement Ergonomic Interventions–Develop and recommend ergonomic solutions to reduce fatigue, enhance productivity, and minimize occupational injuries. ● Apply Regulatory and Industry Standards – Interpret and apply national and international occupational health and safety regulations related to ergonomics in the mineral sector. ● Conduct Ergonomic Assessments–Utilize ergonomic assessment tools and techniques to analyze workstations, postures, and human factors in mining operations. ● Integrate Ergonomics into Safety Management – Incorporate ergonomic principles into risk management and occupational safety programs in mineral industries. ● Develop Research and Case Studies – Critically evaluate real-world ergonomic challenges in mining and propose data-driven recommendations for improvement.

Learning Resources	1. Astrand P-O, Rodahl K, and Dahl H. A. 2003. Textbook of Work Physiology: Physiological Bases of Exercise, 4th edition. Human Kinetics Publishers. 656 pages. 2. Bridger R. S. 2008. Introduction to Ergonomics, Third Edition. CRC Press. 808 pages. Chakrabarty D.1997. Indian Anthropometric Dimensions for Ergonomic Design Practice. 3. National Institute of Design. 161 pages. 4. Corlett E. N. and Clark T. S. 1995 The Ergonomics of Workplaces and Machines: A Design Manual. 2nd Edition. CRC Press. 144 pages 5. Dul J. and Weerdmeester B. Ergonomics for Beginners. A Quick Reference Guide, 3rd Edition. CRC Press. 160 Pages 6. Salve U. R. and Paul A. Ergonomics in Mining: Current Status and Future Challenges. Springer. 7. Stack T. and Ostrom L. T. 2023. Occupational Ergonomics: A Practical Approach, 2nd Edition. Wiley. 560 pages.

Course Code	MN 5222	**Course Name**	Project Planning and Management	**Course Category**	PSE	L	T	P
						3	0	0

Pre-requisite Courses	• Introduction to Mining Engineering, Geology, or Petroleum Engineering • Basic knowledge of project management principles	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course provides a comprehensive understanding of the planning, execution, and management of projects in resource extraction industries, including mining, oil and gas, and renewable energy. Topics include project lifecycle, risk analysis, cost estimation, and sustainable project management.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	**Introduction to Resource Extraction Project Management:** Overview of Project Management; Project Management in Resource Extraction; Project Life cycle and Phases.	3	
2	**Project Initiation and Conceptualization:** Project Identification and Selection; Feasibility Studies; Project Charter and Stakeholder Analysis.	3	
3	**Project Planning and Scheduling:** Work Breakdown Structure (WBS); Gantt Charts and Critical Path Analysis; Resource Allocation and Scheduling.	4	
4	**Cost Estimation and Budgeting:** Cost Estimation Methods; Budget Development; Cost Control and Monitoring.	3	
5	**Risk Management in Resource Extraction Projects:** Risk Identification and Assessment; Risk Mitigation Strategies; Monte Carlo Simulation for Risk Analysis.	3	
6	**Environmental and Regulatory Considerations:** Environmental Impact Assessment (EIA); Regulatory Compliance; Permitting and Approvals.	4	
7	**Safety and Occupational Health in Resource Extraction Projects:** Safety Regulations and Practices; Hazard Identification and Mitigation; Occupational Health in Resource Extraction.	3	
8	**Supply Chain and Procurement Management:** Procurement Planning; Supplier Selection and Contracts; Supply Chain Optimization.	3	
9	**Sustainability in Resource Extraction Projects:** Sustainable Project Management; Environmental and Social Responsibility; Circular Economy and Resource Management.	4	
10	**Project Monitoring and Control:** Key Performance Indicators (KPIs); Project Reporting and Performance Measurement; Change Management.	3	

11	**Project Execution and Resource Allocation:** Project Team Management; Resource Allocation and Utilization; Contractor Management.	3	
12	**Health and Safety Culture in Resource Extraction Projects:** Safety Culture Development; Safety Leadership and Behavior; Case Studies in Safety Excellence.	3	
13	**Case Studies in Resource Extraction Project Management:** Real-world projects and case studies; Student project presentations.	3	
	Total	**42**	

Learning Resources	1. Hickson R. J. and Owen T. L. 2015. Project Management for Mining: Handbook for Delivering Project Success. Society for Mining, Metallurgy, and Exploration. 816 pages 2. Swaine D J. and Welsby D C. 2022. Resource Extraction Projects: Planning, Management, and Sustainability. 3. Benndorf J. 2020. Closed Loop Management in Mineral Resource Extraction: Turning Online Geo-Data into Mining Intelligence. Kindle Edition. Springer. 24914 kB 4. Clark R. M. 1981. Resource Recovery Planning and Management. Project Management (2nd Edition) by Adrienne Watt. 5. Operations and Supply Chain Management by Ashley Mc Donough, Vibrant Publishers (2020). 6. Project Planning, Scheduling, and Controlin Construction: An Encyclopedia of Terms and Applications by Calin M. Popescu and Chotchai Charoenngam. 7. Project Scheduling and Cost Control: Planning, Monitoring and Controlling by JamesC Taylor. 8. Strategic Planning, Execution, and Measurement (SPEM): A Powerful Tool for CEOs by Girish P. Jakhotiya, CRC Press. Additional readings and research articles as provided by the instructor

Course Code	MN 5223	**Course Name**	Environmental Pollution Control	**Course Category**	PSE	L	T	P
						3	0	0

Pre-requisite Courses	• Basics of Environmental Science • Rudiments of Mining Engineering	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course explores the environmental impacts of mining and mineral processing activities, emphasizing pollution control measures. It covers regulatory frameworks, waste management, air and water pollution control, sustainable mining practices, and modern remediation technologies.

Module	**Syllabus**	**Duration (class-hour)**	**Module Outcome**
1	**Introduction to Environmental Pollution in Mining:** Overview of environmental issues in mining and mineral processing Types and sources of pollution; Air, water, noise, and soil contamination Environmental impact assessment (EIA) and life cycle assessment (LCA); Case studies of major environmental disasters in mining.	4	
2	**Air Pollution and Control Strategies:** Air pollutants from mining; Particulates, gases (SO_2, NOx, CO, CO_2, methane) Air quality standards and regulatory frameworks (OSHA, EPA, NAAQS, etc.); Dust suppression techniques; Water spraying, chemical binders, vegetation covers; Gas emission control; Scrubbers, electrostatic precipitators, catalytic converters Case study; Air pollution control in underground vs. open-pit mining.	5	
3	**Water Pollution and Treatment Technologies:** Sources of water pollution: Acid mine drainage (AMD), heavy metals, cyanide, sulfates, Water quality parameters and standards (WHO, EPA, BIS guidelines); Mine water treatment: Sedimentation, neutralization, filtration, biological treatment Sustainable water management; Recycling and zero discharge mining; Case study; AMD prevention and treatment in coal and metal mining.	6	
4	**Soil and Land Contamination Management:** Mining waste types: Tailings, overburden, slag, fly-ash; Impact on soil fertility, erosion, and desertification; Land reclamation and rehabilitation techniques; Tailings management: Lined tailings dams, paste backfill, geo-textile covers; Case study: Successful land reclamation in former mining sites.	5	
5	**Noise and Vibration Control in Mining:** Sources of noise and vibration in mining operations; Health impacts on workers and surrounding communities; Noise measurement standards (OSHA, ISO); Control measures: Blasting optimization, acoustic barriers, equipment modification.	5	
6	**Sustainable Mining and Green Technologies:** Best practices in eco-friendly mining operations; Renewable energy integration in mining (solar, wind, hydropower); Bioremediation and phytoremediation in mining waste management; Sustainable mineral processing techniques (froth flotation, bioleaching).	6	
7	**Environmental Regulations and Policies:** International and national environmental policies (EPA, UNEP, ICMM guidelines); Environmental Impact Assessment (EIA) and	6	

	regulatory compliance; Corporate social responsibility (CSR) and community engagement in mining.		
8	**Case Studies and Emerging Trends:** Case study discussions on successful pollution control projects; Emerging trends: Artificial Intelligence (AI) in pollution monitoring, remote sensing, block chain for environmental compliance; Future of sustainable mining and pollution control.	5	
	Total	**42**	

Course Outcome	By the end of the course, students should be able to: • Understand sources and types of pollution in mining and mineral processing. • Analyse the impact of mining activities on air, water, and soil quality. • Apply pollution control techniques and sustainable mining practices. • Comprehend environmental laws and compliance requirements. • Design and implement pollution mitigation and remediation strategies.

Learning Resources	1. Bell F. G. and Donnelly L. J. 2006. Mining and its Impact on the Environment. Taylor and Francis. 547p. 2. Canter L.W. 1996. Environmental Impact Assessment. McGraw-Hill. 660p. 3. Chaudhuri A. B. 1992.Mine Environment and Management: An Indian Scenario. APH Publishing. 252 p. 4. Down C. G. and Stocks J. 1977. Environmental Impact of Mining. Applied Science Publishers Ltd. 371 p. 5. Eggert R. G. 2013. Mining and the Environment: International Perspectives on Public Policy. Routledge. 180 p. 6. Lottermoser B. G. 2003. Mine Wastes: Characterization, Treatment, and Environmental Impacts. Springer.277 p. 7. Marcus J. J. 1997.Mining Environmental Handbook: Effects of Mining on the Environment and American Environmental Controls on Mining. Imperial College Press. 785 p. 8. Rajaram R. Dutta S. and Parameswaran K. 2005. *Sustainable Mining Practices: A Global Perspective.* Taylor and Francis. 376 p.

Course Code	MN 5291	**Course Name**	M. Tech. project/Term-paper	**Course Category**	PSE	L	T	P
						0	0	3

Pre-requisite Courses	Mini Project-I	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course involves the execution of the research plan formulated in the first phase. Students will collect data, conduct experiments, and analyze results as per their proposed methodology. Interim findings will be documented in a structured progress report.

Module	**Syllabus**	**Duration (class-hour)**	**Module Outcome**
1	Implement their research methodology	9	
2	Conduct experiments or simulations	15	
3	Analyze preliminary findings and interpret results	10	
4	structured progress report summarizing their research progress	8	
	Total	**42**	

Course Outcome	Upon successful completion of this course, students will be able to: • Implement their research methodology systematically. • Conduct experiments or simulations and collect relevant data. • Analyze preliminary findings and interpret results critically. • Prepare a structured progress report summarizing their research progress.

Course Code	MN 5271	**Course Name**	Planning and Design Lab	**Course Category**	PSE	L	T	P
						0	0	3

Pre-requisite Courses	Mining Methods Mine Ventilation	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	The objectives of the Course are: to: • Develop practical skills in mine planning, design, and scheduling. • Familiarize students with tools and software used in mine planning. • Integrate geological, geotechnical, and economic data for developing mine plans. Reinforce theoretical knowledge through laboratory-based applications.

Module	Syllabus	Duration (class-hour)	Module Outcome
1	Geological and Survey Data Interpretation	9	
2	Surface Mine Planning	9	
3	Underground Mine Planning	9	
4	Mine Planning Software (Demonstration and Hands-on)	9	
5	Economic Evaluation and Scheduling	6	
	Total	**42**	

Course Outcome	At the end of this practical course, students will be able to: • Interpret geological and geotechnical data for mine planning. • Prepare and evaluate open-pit and underground mine layouts. • Perform basic design of mine development and production scheduling. • Use mine planning software and tools for layout, scheduling, and optimization. • Demonstrate understanding of reserve estimation, cutoff grade calculation, and mine economics.

Learning Resources	1. Bhattacharya J.(2003): Principles of Mine Planning, 2nd Edition. Allied Publishers Pvt Ltd., New Delhi. 508 pages 2. Darling P (ed.) (2011): SME Mining Engineering Handbook, Third Edition. Two Volume Set. *Society for Mining*, Metallurgy, and Exploration Inc. Littleton, CO, USA.1984 pages 3. HustrulidW. A.,Kuchta M. and Martin R. K. (2013): Open Pit Mine Planning and Design, Two Volume Set & CD-ROM Pack, Third Edition. CRC Press. 1500 pages 4. Martin W. E. 1994. Environmental Economics and the Mining Industry, Volume 4 of studies in risk and uncertainty. Kluwer Academic Publishers, 1994. 130 pages 5. Mathur S. P. (1993): Mine Planning for Coal. M.G. Consultants, Bilaspur. 295 pages 6. Ray S C, and Sinha I N. (2016): Mine and Mineral Economics. PHI Learning Private Limited. 264 pages 7. Runge I. C. 1998. Mining Economics and Strategy. *Society for Mining*, Metallurgy, and ExplorationInc. Littleton, CO, USA. 316 pages. 8. Stermole J. M. and Stermole F. J. 2012. Economic Evaluations and Investment Decision Methods. 13th Edition. Investment Evaluations Corporation, Golden, Colorado. 9. Torries T. F. 1998. Evaluating Mineral Projects: Applications and Misconceptions. *Society for Mining*, Metallurgy, and Exploration Inc. Littleton, CO, USA. 172 pages.

3RD SEMESTER COURSES SYLLABI

M. Tech in Mining and Mineral Engineering

Course Code	MN 6191	Course Name	M. Tech Thesis Part-II (Progress Report)	Course Category	PC	L	T	P
						0	0	24

Pre-requisite Courses	M. Tech. project/Term-paper	Co-requisite Courses	None	Progressive Courses	None
Course Offering Department		Mining Engineering		Data Book / Codes/Standards	None

Course Objectives	This course involves the execution of the research plan formulated in the first phase. Students will collect data, conduct experiments, and analyze results as per their proposed methodology. Interim findings will be documented in a structured progress report.
Course Outcome	Upon successful completion of this course, students will be able to: • Implement their research methodology systematically. • Conduct experiments or simulations and collect relevant data. • Analyze preliminary findings and interpret results critically. Prepare a structured progress report summarizing their research progress.

Course Code	MN 6192	Course Name	Progress Report Seminar and Viva-voce	Course Category	PC	L	T	P
						0	0	0

Pre-requisite Courses	M. Tech Thesis Part-II (Progress Report)	Co-requisite Courses	None	Progressive Courses	None
Course Offering Department		Mining Engineering		Data Book / Codes/Standards	None

Course Objectives	Students will present their research progress in a formal seminar and appear for viva-voce to discuss their findings, challenges faced, and future research directions. Feedback from faculty and experts will help in refining the research approach.
Course Outcome	Upon successful completion of this course, students will be able to: • Present their research progress coherently to an academic audience. • Justify their research methodology and analysis through critical discussions.

	• Receive and incorporate feedback for research refinement. • Develop confidence in defending research findings.

Course Code	MN 6193	**Course Name**	Summer internship (6-8 weeks) evaluation	**Course Category**	PC	L	T	P
						0	0	0

Pre-requisite Courses	None	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	The objectives of the Course are: • To evaluate the professional exposure gained by students during their industrial training or internship. • To develop students' ability to articulate technical knowledge, practical insights, and industry practices in the form of structured reports and presentations. • To assess students' understanding of real-world mining operations, workplace safety, organizational structure, and engineering applications.
Course Outcome	At the end of this sessional course, students will be able to: • Document and communicate their industrial training experience professionally. • Demonstrate understanding of mining operations and work culture. • Relate academic knowledge to industry practices. • Improve technical writing and oral presentation skills. • Develop critical thinking through observation and reporting.

4TH SEMESTER COURSES SYLLABI

M. Tech in Mining and Mineral Engineering

Course Code	MN 6291	**Course Name**	**M. Tech Final Thesis**	**Course Category**	PC	L	T	P
						0	0	30

Pre-requisite Courses	M. Tech Thesis Part-II (Progress Report) Progress Report Seminar and Viva-voce	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course marks the culmination of the M. Tech thesis work. Students will finalize their research, complete data analysis, and compile their findings into a comprehensive thesis document following academic and industry standards.
Course Outcome	Upon successful completion of this course, students will be able to: • Synthesize and interpret research findings effectively. • Draft a well-structured thesis document meeting academic standards. • Demonstrate the significance and originality of their research contributions. • Prepare for final thesis submission and defense.

Course Code	MN 6292	**Course Name**	Thesis Seminar and Viva-voce	**Course Category**	PC	L	T	P
						0	0	0

Pre-requisite Courses	M. Tech. Final Thesis	**Co-requisite Courses**	None	**Progressive Courses**	None
Course Offering Department		Mining Engineering		**Data Book / Codes/Standards**	None

Course Objectives	This course involves the final presentation and defense of the M. Tech thesis. Students will present their completed research work in a formal seminar and defend their findings before a panel of experts. The viva-voce will assess their depth of understanding and contribution to the field.
Course Outcome	Upon successful completion of this course, students will be able to: • Deliver a comprehensive thesis presentation highlighting key findings. • Defend their research work effectively before an expert panel. • Address critical questions and justify their conclusions. • Demonstrate mastery in their area of research and contribute to knowledge advancement.

Learning Resources	1. Alana J. E. and Slater T.2014. Writing your Doctoral Dissertation or Thesis Faster: A Proven Map to Success. SAGE Publications Ltd. 296 pages 2. Creswell J. W. and Poth C N. 2016. Qualitative Inquiry and Research Design: Choosing Among Five Approaches. 4th Edition. SAGE Publications. 488 pages. 3. Dunleavy P. 2003. Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation. Palgrave Macmillan 4. Fisher, C. and Buglear, J. 2004. Researching and writing a dissertation

	for students. Prentice Hall 5. Hyatt Land Roberts C.M. 2023. The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation Fourth Edition. Corwin. 6. 264 pages. 7. Issac R. 2022. Thesis: Beginning to END: Idea to open viva–voce exam. Notion Press, Chennai. 128 pages 8. Krathwohl D. and Smith N. L. 2005. How To Prepare A Dissertation Proposal: Suggestions for Students in Education and the Social and Behavioral Sciences. Syracuse University Press. 289 pages. 9. Negi S. 2022. A Practica l Guide to Modern Research: Thesis and Dissertations - Planning, Writing and Viva-voce. Laxmi Publications. 467 Pages.