Course Name: Applied Rock Mechanics
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

Course Content:

Earthquake engineering, Strength and deformation, Geological structures, Objective and methods of rockmass characterization, Rock Mass Classification, Support Design, Instrumentation & Monitoring, Methods of determination of strength and deformability of rock and rockmass, Failure criteria for rock and rockmass, Mechanics of rock fracture, Failure mechanism of excavation in rock, Influence of anisotropy and discontinuity on rock behaviour, Pre-mining state of stress: sources, methods of determination and presentation, Propagation of elastic waves in rock medium and dynamic behaviour of rocks influencing stress concentration, Zone of influence of an excavation: effect of planes of weaknesses and shape of excavations, Subsidence, Preparation of Stereo-nets, Mechanics of Rock Excavations.

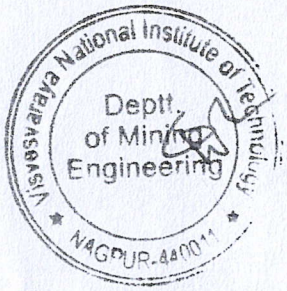
Reference Books

1. Karl Terzaghi, Ralph B. Peck, Gholamreza Mesri Soil Mechanics in Engineering Practice
2. HUDSON, J.A., Rock mechanics series William A. Hustrulid, Michael K. McCarter, Dirk J.A. Van Zyl, Slope Stability in Surface Mining Society for Mining, Metallurgy, and Exploration, Inc
3. HUDSON, J.A. & HARRISON, J.P. (1997). Engineering Rock Mechanics: an Introduction to the Principles. Elsevier.
4. Brady, B. H. G. & Brown, E. T. (1993): Rock Mechanics for Underground Mining, 2nd Edition, Chapman & Hall
5. Goodman, R. E. (1989): Introduction to Rock Mechanics, 2nd Edition, New York: John Wiley & Sons.
6. Hoek, E and Bray, J (1981): Rock Slope Engineering, 3rd Edition, The Institution of Mining and Metallurgy, London

Course Outcomes:

The students will be able to understand:

1. Advanced concepts of rock mechanics and their applications in excavations
2. The use of rockmass classification techniques for strata monitoring and support design
3. Concepts of rock and rockmass failure



Course Name: Construction Management
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

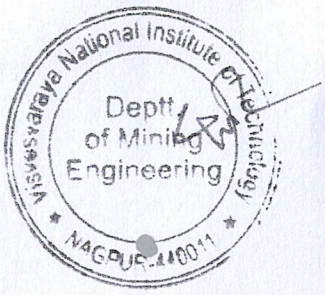
Course Content:
Introduction to Preparation of Construction Contract, Provisions, and Clauses, Drafting of Contracts, Legal provisions of contract, Negotiations, Tenders, Bids Preparation, Quality Based Selection, Cases of Excavation and Construction Contract, Construction management practice, Best Practices Project Management, Schedule Preparation, Time Management in Work Execution, Software for Contract and Construction Management, Work Scheduling, Resource Allocation, Relevant Codes for Excavations, Permissions from Government and Other Agencies, Finance and economics, Financial Risk Managements, Project Scheduling, Costing.

Reference Books

1. Dave Roberts, Pipe and Excavation Contracting, Published by:
2. Craftsman Book Company P.O. Box 6500, Carlsbad, CA 92018
3. Excavating and Grading Handbook
4. Indian Contract Act, GFR, other CVC guidelines

Course Outcomes:
The students will be able to understand:

1. Intricacies of drafting of modern contracts and the art of putting them into practice.
2. Legal aspects of contract and construction management.
3. The best practices of contract management and the use of software.



Course Name: Environmental Impact of Excavation
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

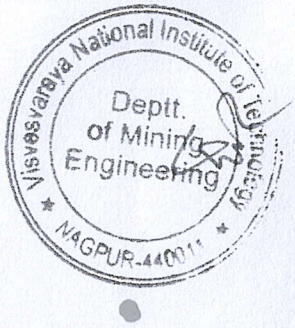
Course Content:
Air Pollutants including Dust & Gas, Air Quality Index, Water Pollution & Contaminants, Loss of water due to excavation, Land Pollution, Excavation Practice in Contaminated Land, Land Environment Sensitivity and Tolerance Land Suitability and Use, Soil Materials Physical Properties, Soil-Water Systems, Sustainable and Best Practices for environmental management in excavations. EIA, ERA, EMP, emergency & disaster management in excavations.

Reference Books

1. Lakshmi N. R., Hilary I. I., (2000): Geoenvironmental Engineering: Principles and Applications, Marcel Dekker
2. Car, Y. B. and Daniel, D. E., (1995): Geoenvironmental 2000 - Characterization, Containment, Remediation, and Performance in Environmental Geotechnics, Geotechnical Special Publication No. 46, ASCE Press, New York, USA.
3. Bear, J. and Verruijt, A. (1990): Modelling Groundwater Flow and Pollution, Reidel P.C., Dordrecht, The Netherlands.
4. Bedient, P. B., Rifai, H. S. and Newell, C. H. (1994): Ground water contamination-Transport and Remediation, PTR Prentice Hall, NJ, USA.
5. Daniel, D. E., (1993): Geotechnical Practice for Waste Disposal, Chapman & Hall, London.

Course Outcomes:
The students:

1. Will have awareness about environmental concerns of excavation
2. Will exhibit the knowledge about environmental documentation



Course Name: Advanced Excavation Techniques
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

Course Content:
Dynamic Rock Breakage Mechanisms, Recent Advances in Drilling and Blasting, Controlled Blasting Techniques, Use of Innovative Techniques in Conventional Drilling and Blasting, Non-blasting Interventions in Mining and Excavation

Reference Books

1. Langefors, U. and Kihlström, B., 1963. The modern technique of rock blasting (Vol. 405). New York: Wiley.
2. Drilling and Blasting of Rocks, By C. Lopez Jimeno, E. Lopez Jimeno, Francisco Javier Ayala Carcedo Hustrulid
3. Konya, C.J. and Walter, E.J., 1991. Rock blasting and overbreak control (No. FHWA-HI-92-001, NHI13211). United States. Federal Highway Administration.
4. Engineering rock blasting operations: S. Bhandari, A. A. Balkema Pulb

Course Outcomes:
The students will be able:

1. To know various types, applicability, classification of drills.
2. To design a blast
3. To learn rock breakage mechanism, blast evaluation techniques and blasting software.
4. To understand environmental effects of blasting, controlled blasting and special blasting techniques.

Course Name: Pillar Design in Underground Mines
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

Course Content:
Challenges and Case Studies in optimizing the pillar design, Design consideration issues for natural pillars, Models of pillar failure, Pillar failure in coal and metal mines. Pillar stabilization. Analytical, Empirical and Numerical Approach to design the natural pillar. Introduction to finite element method software and its use in determining factor of safety and extent of plastic zone in natural pillars.

Reference Books

1. Brown, E.T. and Hoek, E., 1980. Underground excavations in rock. CRC Press.
2. Ramamurty, G., 2013. Applied Finite Element Analysis. IK International Pvt Ltd.
3. Deb, D. and Kumar, V.A., 2016. Fundamentals and applications of rock mechanics. PHI Learning Pvt. Ltd.
4. Tatiya, R.R., 2005. Surface and underground excavations: methods, techniques and equipment. CRC press.
5. Gertsch, R.E. and Bullock, R.L., 1998. Techniques in underground mining: Selections from Underground mining methods handbook. (No Title).
6. ANSYS Workbench Version 23.0 User Manual

Course Outcomes:
The students will be able:

1. To understand the challenges encountered in pillar design in underground mines
2. To understand the factors contributing to pillar failure in underground mines
3. To learn the different approaches to design a pillar in underground mines

Course Name: Project Management for Excavations
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

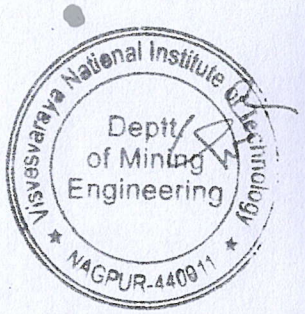
Course Content:
Introduction to Project Management
Nature and Purpose, Systems Approach to Project Management, and the Development of Project Management Project Definition, Project Characteristics, Project Performance Dimensions, Project Life Cycle, Project Classification What is Project Management. Features of Project Management, Benefits of Project Management Approach, The necessity, characteristics, and Uses of Project Management in the Excavation Sector Project Planning
The planning process, objectives, tactics, and policies determine planning effectiveness, the process of developing plans overlapping precedence diagrams, network analysis, master and sub-networks, and time-scaled networks
Resource scheduling: Resource allocation and aggregation time-cost trade-offs, line of balance float factor levelling and smoothening concepts, and difficulties related to project multi-resource scheduling: both easy and difficult, crashing
Organizing the projects
Financial Analysis Mining Costs.
Break Even Analysis. Net Present Value (NPV). Internal Rate of Return (IRR). Incorporating risk in the NPV calculation. Sensitivity analysis Project comparison on costs

Reference Books

1. Project Management Institute (PMI). (2017). A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 6th Edition. PMI.
2. Larson, E., & Gray, C. (2020). Project Management: The Managerial Process, 8th Edition. McGraw-Hill Education.
3. Schwalbe, K. (2019). Information Technology Project Management, 9th Edition. Cengage Learning.

Course Outcomes:
The students will be able:

1. Capable of understanding behavioral theories and basic project management principles
2. Capable of putting .project management techniques into practice in the excavation industry
3. Capable of planning, organization and financial management of projects



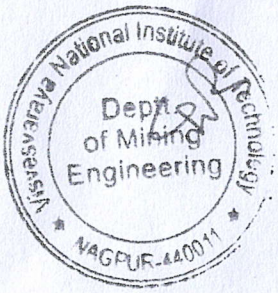
Course Name: Rock Blasting - Operation and Design
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

Course Content:
Rock breakage by explosives theories, laws of comminution, methods for prediction and assessment of fragmentation. Physico-chemical properties of explosives and selection method. Techno-economic analysis. Types of Explosives, bulk explosives, explosive selection, initiation and priming devices for explosives. Design of blasting rounds for surface and underground excavation, special blasting techniques- including secondary breakage, Controlled blasting technique, pre-splitting, destress blast technique, casting and demolition, environments considerations, Safety aspects of explosives and blasting. Blasting optimization, intelligent blast design, blast economics, computer applications in blasting

Reference Books

1. Dr. Calvin Konya, Rock Blasting and Overbreak Control
2. Stig o Olofsson, Applied Explosive Technology for Construction and Mining
3. Rock Blasting Operation: S. S. Bhandari
4. Surface Blast Evaluation: N. R. Thote, G. K. Pradhan

Course Outcomes:
The students will be able:



Course Name: Rock Engineering Design
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

Course Content:

Introduction, Intact rock and Rock mass Properties: Introduction to Rock Mechanics, Concept of stress and strain in rock, Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks. Introduction to elementary rock mass classifications based on strength, hardness and RQD. Determination of physical properties, strengths, strength indices and static elastic constants, parameters influencing strength, abrasivity and its determination.

Stresses in Rock and Rock reinforcement techniques: Insitu stresses, methods of determination including over-coring and hydro-fracturing methods. Terminology used in rock reinforcement, pressure arch theory, support and reinforcement principles and design, classification of mine supports

Time dependent and Dynamic properties of rock and rock mass, Failure criteria for rock and rock mass: Propagation of elastic wave in rock media, determination of properties and elastic constants. Creep deformation and strength behaviour, creep test and rheological models. Theories of rock failure, Coulomb, Mohr and Griffith criteria, empirical criteria.

Distribution of stress patterns around openings. Introduction to methods of stress analysis. Predictive methods for mine design, principles of classical stress analysis, closed form solutions for simple excavation.

Monitoring Rockmass Performance: Purpose and nature, monitoring systems including seismic and microseismic methods.

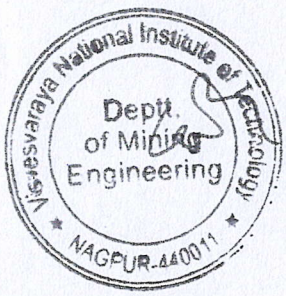
Introduction to computational methods of stress analysis - finite element, boundary element, distinct element methods and hybrid computational schemes.

Reference Books

1. Manual on Rock Mechanics: Ramamurthy & Sharma, CBIP Publ.
2. Rock Engineering: John Franklin and Maurice Dusseault, McGraw-Hill Publ. comp
3. Rock Mechanics for hard rock mining: Jumikis

Course Outcomes:

1. To make students conversant with different types of rock mass about design of excavations and methods of designing
2. To acquaint students with various types of supports and reinforcements as well as permanent supports of excavations
3. To make them conversant with ground control and subsidence problems and preventive measures.
4. To understand the knowledge basic of stress analysis, rock modelling and soil mechanics to be applied for design of rock structures.



Course Name: Safety Engineering and Management
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

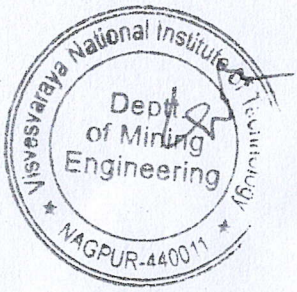
Course Content:
Overview of safety engineering and management, Importance of safety in industries, Safety regulations and standards. Hazard Identification and Risk Assessment: Types of hazards Risk assessment techniques, Hazard identification methods. Engineering and Administrative controls for enhancing safety, Emergency preparedness and response. Occupational health hazards, Ergonomic principles and applications, Designing for safety and ergonomics. Safety management system (SMS) framework, Safety policy, objectives, and targets, Safety performance monitoring and measurement

Reference Books

1. "Safety Engineering and Management" by Daniel A. Crowl and Joseph F. Louvar
2. Safety Engineering and Management" by Daniel A. Crowl and Joseph F. Louvar
3. Industrial Safety Management: Hazards, Risks, and Control Measures" by S. Z. Mansoor*:
4. Safety Engineering: Principles and Practices" by G.Peters
5. OSHA guidelines and regulations
6. Industry-specific safety standards and guidelines

Course Outcomes:

1. .



Course Name: Surface Mine Planning
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

Course Content:

Mine Planning Principles: Basic principles of mine planning, Mine life cycle: from exploration to closure, Legal and regulatory considerations in mine planning, Environmental and social considerations Stages/Phases of mine life, Preliminary evaluation of surface mining prospects, Mine, Mining revenues and costs, and their estimation, Mine planning components, planning steps and planning inputs.

Pit Planning: geometrical considerations in pit configuration, mine development phases, quality control and conservation. Output and manpower planning, short vs long range planning, facilities planning, Criteria for selecting surface mining methods,

Pre-Feasibility analysis and Feasibility Report - Contents and preparation. Mine layouts, pit slope geometry, stripping ratios, Choice of mining system, determination of ultimate pit,

Mine Layout and Infrastructure Design: Considerations for mine infrastructure (offices, workshops, etc.)

Equipment management: Overview of surface mining equipment, Criteria for equipment selection, Productivity analysis of mining equipment, Power supply arrangements in opencast mines.

Reference Books

1. Hartman, H.L., & Mutmansky, J.M. (2002). Introductory Mining Engineering. Wiley-Interscience.
2. Hustrulid, W., Kuchta, M., & Martin, R. (2013). Open Pit Mine Planning and Design, Two Volume Set & CD-ROM Pack, Third Edition. CRC Press.
3. Bhattacharya, J. (2013). Principles of Mine Planning. Allied Publishers.
4. Software manuals and tutorials (SURPAC, MineSight, Whittle, etc.)

Course Outcomes:

1. .

Course Name: Underground Excavation Techniques
Course Code: MNLXXX
Credits (L-T-P): 3-0-0

Course Content:

Introduction: Need for and Importance of underground excavation, Types of underground excavations, Applications of underground excavations, Economics of underground excavations. Planning and Design of underground excavations: Need for site investigation, Excavation hazards and their prediction, Design and selection of support and reinforcement, Excavations in difficult ground conditions. Excavation Methods: Conventional excavation principles, Mechanized excavation principles, Excavation equipments. Sustainable practices in underground excavations.

Reference Books

1. Kuesel, T.R., King, E.H. and Bickel, J.O., 2012. Tunnel engineering handbook. Springer Science & Business Media.
2. Singh, B. and Goel, R.K., 2011. *Tunnelling in weak rocks*. Elsevier.
3. Tatiya, R.R., 2005. *Surface and underground excavations: methods, techniques and equipment*. CRC press.
4. Clayton, C.R., Matthews, M.C. and Simons, N.E., 1982. *Site investigation* (No. Monograph). London, UK: Granada.
5. Clayton, C.R.I., 2009. Urban site investigation. *Geological Society, London, Engineering Geology Special Publications*, *22*(1), pp.125-141.

Course Outcomes:

The students will be able to understand:

1. Need for and importance of underground space.
2. Importance of site-investigation and its various features for the creation of underground space.
3. Conventional methods of developing underground spaces.
4. Modern Methods of developing underground spaces.