Course Outline

Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NGLC519	Elements of Rock Engineering	3	0	0	3

Course Objective

The primary objective of the course is to introduce fundamental and advanced aspects of rock engineering through engineering geological investigations.

Learning Outcomes

Upon completion of the course, students will be able to:

- Understand the engineering properties of rocks and their behaviour during excavations in mining and rock engineering project.
- Carry out geo-engineering design for both surface and sub-surface structures.
- Understand the application of AI/ML in elements of rock engineering.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Introduction:** Objective, scope and problems of rock engineering.	3	Introduce to theoretical and practical aspects of rock engineering.
2.	**Physico-mechanical properties of rock:** Physico-mechanical properties of rock, Laboratory tests for various physical and mechanical properties, Field shear test, Deformability tests in rock mass, Hardness and abrasiveness.	6	Understand the physico-mechanical properties of rock.
3.	**Engineering rock mass Classification:** Engineering classification of intact rock and rock masses, Rock mass classifications in support design, Predicting rock mass quality using AI/ML.	7	Concept of engineering rock mass classification. Understand the application of AI/ML in rock quality prediction.
4.	**State of stress and failure criteria of rockmass:** Concept of Stress and strain, Failure criteria for rock and rock masses, Mohr-Coulomb Criterion, Hoek-Brown Criterion; Insitu stress, Various methods of stress measurement, Hydrofracturing technique, Flat jack technique, Overcoring technique.	6	Understand the stress and failure criteria of rockmass.
5.	**Strength of discontinuities:** Strength and deformability of jointed rock mass, Shear strength of rock joints, Dynamic shear strength of rock joints, Deformability of rock joints, Joint wall roughness coefficient, Joint wall compressive strength, Normal and shear stiffness of rock joints, Fracture toughness, Thermal and hydraulic properties of rock .	6	Know about strength and deformability of jointed rock mass.
6.	**Slope engineering:** Modes of slope failure; Planar, wedge, topping and circular failures analyses, monitoring of slope movements, stabilization of rock slopes, machine learning algorithms for slope stability classification and prediction.	7	Concept of mechanism of slope failure. Prediction of stability of slopes using machine learning regression and classification methods.
7.	**Numerical methods:** Numerical modeling of rocks and rock masses, Application to tunnels, caverns and slopes.	3	Learn about numerical methods and its applications.
8.	**Applications:** Foundation on rocks, Rapid landslide hazard zonation, Improvement of rock mass responses, Problems associated with deep excavations (Mines, Tunnels, Underground Chambers) and energy development (Petroleum, Geothermal, Nuclear, Energy Storage Caverns), Highway transport system.	4	Applications of rock engineering.
	Total Classes	42	

Text Books:

1. Jaeger, J.C; Cook, N.G.W. and Zimmerman,R, Fourth Edition, Fundamentals of Rock Mechanics, Blackwell Publishing, 2007.

2. Goodman, R.E., Introduction to Rock Mechanics, Second Edition, John Wiley & Sons, 1989.

Reference Books:

1. Hudson, J.A. et al. (Ed.), Comprehensive Rock Mechanics, in 5 volumes, Pergamon Press, 1993.

2. Ramamurthy, T., Engineering in Rocks for Slopes, Foundation and Tunnels, Prentice Hall India Pvt. Ltd., 2014.