Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NMNC516	Mining Equipment Reliability, Maintainability, and Availability	3	1	0	4

Course Objective

The course 'Mining Equipment Reliability, Maintainability and Availability' aims to develop a comprehensive understanding of philosophy of the reliability and maintainability engineering in underground and opencast mining machineries so that optimum utilization of the mining equipment can be achieved with no/insignificant harm to the system safety such as humanbeing, property, and other items. Hence, the course covers the general aspects of equipment reliability, maintainability and availability within the mining system.

Learning Outcomes

Upon successful completion of this course, students will:
- be able to understand the basics concept of reliability and maintainability.
- get to know the mathematics & probability distribution as tools to be applied in reliability engineering.
- have a broad understanding of reliability and its techniques to be used in mining equipment performance evaluation.
- able to learn about the basics of maintainability and its application in mining equipmentmaintenance.
- be able to impart the knowledge and skill in the domain of reliability engineering to better utilization mining equipment particularly in competitive world.

Units	Course Content	L+T	Learning Outcomes
Unit 1	**Introduction:** The Study of Reliability and Maintainability; Concepts, Terms, and Definitions; Applications; A Brief History; Need for Improving Mining Equipment Reliability, Maintainability, and Availability; Mining-equipment-related Facts and Figures based on Reliability.	5L+1T	Understanding the reliability engineering and its importance in miningengineering in particular performance of mining equipment.
Unit 2	**Reliability Statistics and Probability Distributions** **Reliability Statistics:** Basic statistics – mean,mode, median, standard deviation, variance, etc. Correlation and regression; Probability Definition and Properties; Cumulative Distribution Function, Probability Density Function, Reliability Function Expected Value, Variance. **Probability Distributions:** Discrete and Continuous Distribution, Binomial Distribution, Poisson Distribution, Weibull Distribution, Normal Distribution, Lognormal Distribution; Gamma Distribution	12L+ 4T	Understanding the application of statistics & probability distribution in reliability engineering.
Unit 3	**Mining Equipment Reliability** **Concept and its Tools:**	13L+5T	Understanding the fundamentals and technics of

	The Reliability Function; Mean Time to Failure; Hazard Rate Function; Bathtub Curve; Condition Reliability; The Exponential Reliability Function; Failure Modes; Redundancy and the Constant Failure Rate Model - General Reliability Function, Hazard Rate Function, Mean Time to Failure; Reliability Networks - Series Configuration, Parallel Configuration, Combined Series and Parallel System; Commonly Used Methods in Reliability Analysis – FMEA, FMECA, Markov Method, Fault Tree Analysis, etc. **Application of Reliability Engineering in Mining Equipment:** Reasons for Improving Mining Equipment Reliability, Factors Impacting Mining System Reliability, and Useful Mining-Equipment-Reliability-Related Measures; Open- Pit-System Reliability Analysis; Designing Reliable Conveyor Belt Systems; Fault Tree Analysis of Shovel; Dump-truck Tire Reliability and the Factors Affecting Their Life, Case studies.			reliability and its application mining equipment performance evaluation.
Unit 4	**The Repair Process and the Design for Maintainability:** Analysis of Downtime; The Repair-Time Distribution; Stochastic Point Processes; System Repair Time; Reliability Under Preventive Maintenance; Maintenance Requirements; Design Methods; Human Factors and Ergonomics; Maintainability Prediction and Demonstration	8L+2T		Understanding the fundamentals of maintainability and its application in mining equipment maintenance
Unit 5	**Concept of Availability and its Application in Mining Equipment:** Concepts and Definitions; Exponential Availability Model, System Availability; Inspection and Repair Availability Model	4L+2T		Understanding the concept of the availability so that prior step will be taken to optimum use of mining equipment.
	Total	**42L+14T**		

Textbooks:
1) Mining Equipment Reliability, Maintainability, and Safety by B. S. Dhillon, Springer, 1st Edition, 2008.
2) An Introduction to Reliability and Maintainability Engineering by Charles E. Ebeling, Edition, 2010, Waveland Press, Inc.; 3rd edition (12 April 2019)

Reference Books:
1) Mine Health and Safety Management – Edited by Michael Karmis
2) Reliability Engineering - Theory and Practice by A. Birolini, Springer
3) Engineering Maintenance: A Modern Approach by B. S. Dhillon, CRC Press, Boca Raton, Florida
4) Case Studies in Reliability and Maintenance by W.R. Blischke. and D.N.P. Murthy, John Wiley & Sons, USA