Course Type	Course Code	Name of Course	L	T	P	Credit
DE2	**MND 401**	**ADVANCED MINE VENTILATION**	3	0	0	9

Course Objective

This course will impart theoretical and practical knowledge for solving the real life ventilation problems both in coal and hard rock underground mines. In addition, the students will be acquainted with a number of case studies demonstrating the intricate ventilation problems faced in Indian underground mines and development of methods for solving those problems.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of heat flow problems as existing in underground (UG) mines.
- detailed understanding of all the methods of heat and mass transfer to ventilating air.
- be able to compute the resultant thermodynamic properties of ventilating air in bord and pillar, and longwall panels.
- be in a position to take ameliorative measures for improvement of workplace environment in UG mines.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Unit – 1 : Introduction and basics of Mine Thermodynamics:** Overview and Importance of Advanced Mine Ventilation; Basics of mine thermodynamics, earth crust-infinite reservoir of heat and variation of strata temperature with depth; Computation of thermodynamic properties of mine air. Heat transfer in mine airways : Unsteady/Transient state, Quasi-steady state and Steady state heat transfer, Heat transfer due to conduction, logarithmic mean area approach and related problems, Heat transfer due to convection and radiation in mines and related problems, Heat transfer at wet surfaces, computation of rate of condensation and evaporation in mine air airways and conceptual problems; Computation of heat transfer in tunnels depending upon age factor with numerical problems	10	Understanding the basics of heat flow into mine air through conduction, convection, radiation and evaporation from dry and wet surfaces and resultant change in thermodynamic properties of ventilation air.
2	**Unit – 2 : Heat flow into bord and pillar, and longwall workings:** Heat and mass transfer in bord and pillar panels, development of equations and calculations for designing climatic condition; Heat and mass transfer in longwall panels : Sources of heat in longwall panels, Computation of heat load and climatic conditions in mine workings, Mitigative measures for hot and humid workings, longwall ventilation practices : Global experience, A case study of a deep, hot and humid mine of the country	7	The students will understand the heat flow problems in bord and pillar, and longwall workings and methods of computing the same. They will be enriched by the case studies and also the global experience on the subject.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
3	**Unit – 3 : Incompressible flow ventilation network analysis:** Computation of volume flow using equivalent resistance method and numerical examples, Computation of volume flow using direct analysis : Application of Kirchoff's first and second laws to solve field problems, Derivation of Hardy Cross Iterative method, Application of Hardy Cross Iterative method to solve complex mine ventilation network problems, Some typical case studies on the design of ventilation system through ventilation network analysis from Indian coal and hard rock mines	9	The students will learn the incompressible flow ventilation network analysis with case studies from deep and gassy coal mines, and also from highly mechanized mines of the country.
4	**Unit – 4 : Compressible flow mine ventilation network analysis:** Thermodynamic principles applied to mine ventilation network analysis : Development of equation considering no change of moisture content and application of these equations, Comparison of these equations with Bernauli's equation and concept of pseudo-pressure equation, Application of these equations to complete mine circuit, Development of equation considering change in moisture content, Application of these equations to complete mine circuit, Computation of resistance of mine roadways with change in moisture content using Atkinson's equation and Darcy weisbach equation with related numerical problems	7	The students will know the details of compressible flow ventilation network analysis and its use in actual mine condition.
5	**Unit – 5 : Mine air conditioning:** Improvement of workplace environment in underground : Basic vapour compression cycle, pressure-enthalpy diagram and super-imposition of pressure-enthalpy diagram on vapour compression cycle, A case study of design mine air-conditioning/cooling system	6	To understand the ameliorative measures for improving the workplace environment in underground mines.
6	**Unit – 6 : Automation and control:** Advanced underground environment monitoring systems, automation and control	3	To understand the environmental monitoring and control systems used in UG mines

Text Books:

1. Subsurface Ventilation and Environmental Engineering : Prof. M. J. McPherson
2. Mine Ventilation and Air Conditioning : Prof. H. L. Hartman, Prof. Jan Mutmansky and Prof. Y. J. Wang

Reference Books:

1. Mine Environmental Engineering, Vol. 1 & Vol. 2 : Prof. Mritunjoy Sengupta
2. Environmental Engineering in Mines : Dr. V. S. Vutkuri and Dr. R. D. Lama
3. Mine Ventilation : Prof. S. P. Banerjee
4. Mine Environment and Ventilation : Prof. G. B. Mishra
5. 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, and 12th International Mine Ventilation Congress Volumes