Course Type	Course Code	Name of the Course	L	T	P	Credits
DC2	**NMNC502**	**Computational Subsurface Ventilation and Environment**	3	1	0	4

Course Objective

The course objective is to impart knowledge for planning and designing ventilation systems to improve the workplace environment in underground mines and tunnels. In addition, the students will be acquainted with a number of case studies demonstrating ventilation planning for solving real-life ventilation problems in deep underground mines and tunnels.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of the computation of heat load and climatic conditions in mine workings.
- learn the incompressible flow ventilation network analysis.
- be able to evaluate the performance of mine fans.
- have a broad understanding of the measurement of various ventilation and environmental parameters in underground mines and tunnels

Unit No.	Topics to be Covered	Lecture Hours +Tutorials	Learning Outcome
1	**Ventilation thermodynamics and heat transfer in mine workings:** Basics of mine ventilation thermodynamics; computation of psychrometric properties of mine air; heat transfer in mine airways due to conduction, convection and radiation; heat transfer at wet surfaces; computation of rate of condensation and evaporation in mine airways; simple method of heat transfer in tunnels; heat and mass transfer in bord and pillar panels and development of equations for designing climatic condition; sources of heat in longwall panels; computation of heat load in mines; simulation of the climatic condition in longwall panels; relevant numerical problems.	(8L+4T)	The students will learn 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. The students will also understand the heat flow problems in bord and pillar, and longwall workings and methods of computing the same
2	**Mine air conditioning**: Improvement of workplace environment in underground: Basic vapour compression cycle, pressure-enthalpy diagram and superimposition of pressure-enthalpy diagram on vapour compression cycle, A case study of design mine air-conditioning/cooling system	3L+0T	To understand the ameliorative measures for improving the workplace environment in underground mines.
3	**Ventilation network analysis for incompressible flow:** Computation of airflow using equivalent resistance and direct analysis methods; Equivalent orifice; Losses in airways; Economic design of airways; Ventilation flow control devices; Permissible air velocities in different types of workings/openings; Standards of ventilation; application of Kirchhoff's laws to solve ventilation problems; Hardy-Cross iterative technique for solving complex mine ventilation	(8L + 4T)	The students will learn the incompressible flow ventilation network analysis with case studies for underground metal and coal mines

	network problems; computer simulation of ventilation networks; ventilation on demand (VOD); relevant numerical problems.		
4	**Mine ventilation fans**: Fan laws, Fan characteristics curves, auxiliary ventilation system, Booster Fan,	(6L + 2T)	Students will understand the selection of mine fans and their positions in the underground mines.
5	**Controlled recirculation**: Air leakages, Concept of controlled recirculation, design of controlled recirculation system for long headings and working panels.	3L+0T	Students will learn the design criteria to control air recirculation in underground headings and working places
6	**Mine fire, gases, and dust:** Fires in developed coal seams and the control measures; gas content and gas emission characteristics of coal; environmental monitoring in mines- online tele-monitoring system, tube-bundle system, airborne respirable dust and its control; diesel particulate matter control in underground mines;	(6L + 2T)	understand the environmental monitoring and control systems used in the mines
7	**Illumination and Noise survey:** Standards of lighting, Lighting systems and fixtures-fixed and mobile illumination systems; emergency lighting; Noise survey; Noise Standards and Guidelines; Noise Control	4L+0T	Students will learn the design of illumination system in the mines and also noise standards and guidelines. .
8	**Tunnel Ventilation and environment:** Gas emissions and their permissible limits in tunnels, estimation of airflow rate and pressure requirement for tunnels, ventilation during tunnel construction, highway tunnel ventilation systems, diesel exhaust and control in tunnels, smoke control in tunnels; relevant numerical problems.	(4L + 2T)	Students will learn the different types of tunnel ventilation system.
		42L+14T (56)	

Text Book:

1. Subsurface Ventilation and Environmental Engineering by M. J. McPherson, 2012

Reference Books:

1. Mine Ventilation and Air Conditioning: H. L. Hartman, Jan Mutmansky and Y. J. Wang
2. Mine Environmental Engineering, Vol. 1 & Vol. 2: Mritunjoy Sengupta
3. Environmental Engineering in Mines : V. S. Vutkuri and R. D. Lama
4. Mine Ventilation: S. P. Banerjee
5. Mine Environment and Ventilation: Prof. G. B. Mishra
6. Advanced mine ventilation: Pramod Thakur
7. Prevention and combating mine fires: S.C. Banerjee
8. Road Tunnel Ventilation -Petr Pospisil