

Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NMNC521	Planning and Design for Tunnels and Caverns	3	1	0	4

#### Course Objective

- This course deals with the principles, processes and methodologies associated with tunnel and underground space planning.
- The course will expose the students of civil / mining engineering background with concepts of planning and design for tunnel and underground space.
- The students will be introduced to recent developments and mathematical algorithm associated with the planning and design.

#### Learning Outcomes

- The learner will be able to plan and design both Tunnels and caverns with all the steps to be followed starting from the parameters required in planning and proposing tunnel location to the post construction monitoring of underground excavations, apart from these the risk assessment and Feasibility analysis aspects can also be appreciated.

Units	Course Content	L+T	Learning Outcomes
<b>Unit 1</b>	Need for Underground Space: <i>Engineering and Strategic Utilities</i> , Planning and design process for excavation of roadways, tunnels and caverns, Tunnel Layout	03 (L)	Understanding the requirement and process of planning and design of U/G structures
<b>Unit 2</b>	General Concepts: Benefits and draw backs, classification and configurations, psychological and physiological effects, Legal and administrative issues, exterior and entrance design, layout and spatial contributions	03 (L) + 01 (T)	Factors affecting pre and post construction activities of Tunnels and Caverns
<b>Unit 3</b>	Geo-Engineering Investigations: Topographical and geological survey, augering, drilling, soil and rock sampling and testing, preparing sub-surface geological cross section, georadar use and data analysis for shallow tunnels, geophysical investigations to prove deeper sub-surface features, Geotechnical investigation, Physico-mechanical properties and collection of rock mechanical data, stability analysis and identification of failure	08 (L) + 02 (T)	All preliminary investigations and their requirement
<b>Unit 4</b>	Planning and Design: Determination of appropriate location, size, shape and alignment, Assessment of behavior of tunneling media - deformation modulus and support pressure measurement, instrumentation and monitoring of rockmass performance, application of numerical modelling in space design, earthquake effects on tunnels, design of underground space in rocks with the help of field data.	08 (L) + 02 (T)	Basic design and planning parameters followed with codal provisions
<b>Unit 5</b>	MEP: Mechanical, Electrical and Plumbing Services for Tunnels and Caverns	03 (L)	Services in Tunnelling
<b>Unit 6</b>	Case Studies of Planning and Design: Metro,	05	Different case studies

	Highway tunnel, Underground station, Storage of oil & gas, food, Hydro Tunnels/Sewage Treatment Plants	(L)+01 (L)	related to tunnel construction
<b>Unit 7</b>	Soft Ground Tunneling: Design Considerations, Lining Type, Short Term and Long-term Behavior, Subsidence, Instrumentation and Monitoring	04 (L) + 01 (T)	Design Considerations in Soft Ground Tunnelling
<b>Unit 8</b>	Planning for Excavation methods: Selection, planning and design for each method through cycle time study	04 (L)	Cycle time study of various construction activities
<b>Unit 9</b>	Trenchless Technologies: Horizontal directional drilling, Micro Tunneling, Boring equipment	05 (L) + 02 (T)	New development and recent techniques
<b>Unit 10</b>	Feasibility assessment and Report preparation for tunnels and caverns	03 (L) + 01 (T)	Report preparation and feasibility study
	Total	42+14	

**Textbook:**

- 1) Underground Infrastructures, Planning, Design and construction by Goel, R. K., et. al. Elsevier, 2012
- 2) Whittaker B.N. and Frith, R.C. (1990), Tunnelling: Design, Stability and Construction, IMM

**Reference Books:**

- 1) Underground Spaces Unveiled, By Admiraal, H. et al., ICE, 2018.
- 2) Tunnelling: Design, Stability and Construction Books, by Barry N. Whittaker, Russell C. Frith, IMM publication, 1990