Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NMNC523	NATM and TBM Tunnelling	3	1	0	4

Course Objective

- New Course and is the basic requirement of tunnelling and construction industry.
- NATM provides more cost effective, flexible (build-as-you-go) and safe tunnelling particularly for short stretches (<2 km) and applicablein varied geology. This involves use of DBM and/or Road header as excavation techniques.
- Medium hard to soft rock mass can be dealt with effectively using this technique with least surface disruption. Whereas as TBM technology is best suited for wide range of ground conditions for meeting long and rapid drivage requirements. Applicability of these techniques is growing rapidly in urban (water supply/metro/irrigation/sewage tunnels) and strategic infrastructure development (Roads, Railways, Storage, nuclear waste disposal etc.).

Learning Outcomes

- The learner will be able to plan and design both NATM and TBM systems of tunnelling involving use ofDBM and/or Road header and TBM excavation techniques. Apart from these the risk assessment and contractual aspects also can be appreciated.

Units	Course Content	L+T	Learning Outcomes
Unit 1	Geotechnical/hydrological investigations: Laboratory tests andsite investigations including Tunnel seismic profiling and Rock mass classification systems	03(L)	Site geotechnical investigations of rock mass
Unit 2	Tunnelling with DBM: design and operating features, special features enabling efficient advance including controlledblasting techniques	03(L)+01(T)	Excavation by drillingand blasting
Unit 3	Tunnelling with Road headers: Machines, types, capacities,design and operating features, special features enabling efficient cutting	03(L)+01(T)	Mechanical excavation by road headers
Unit 4	Tunnelling with Tunnel Boring Machines: Machines, types,capacities, design and operating features, special features enabling efficient boring	03(L)+02(T)	Mechanical excavationby TBM
Unit 5	Rock mass drillability/cuttability/boreability, Linear Cuttingtests	03(L)	Rock mass assessment tests
Unit 6	Excavation system design (Drill, Road header and TBM Cutterheads)	03(L)+01(L)	Design principles for tunneling
Unit 7	Performance prediction and optimization: Drills/Road headers/TBMs	03(L)+02(T)	Performance prediction and optimization of tunneling
Unit 8	Bit/Tool/Cutter wear prognosis	04(L)	Bit wear studies
Unit 9	Support design and instrumentation: shotcrete, wire mesh, rock bolting, lining, ground stabilization	05(L)+02(T)	Ground stability analysis

Unit 10	Supporting Infrastructure and site layout for DBM/road header/TBM application, Cycle time analysis, Cost estimation	03(L)+02(T)	Planning and execution of tunneling methods
Unit 11	Selection of machine and method or a given case, Technical economic feasibility Assessment	03(L)+01(T)	Excavator selection and feasibility study
Unit 12	Tendering, Award of Contract	02(L)	Tendering
Unit 13	• Geotechnical investigations and rock mass characterization for method selection • Drill and Blast design • Cuttability assessment and design of road header • Boreability assessment and design of TBM • Design of support system for NATM/TBM • Cycle time assessment and techno-economic feasibility for NATM/TBM	04(L)+02(L)	Summary of excavation methods
	Total	42-14	

Textbooks:

1) Whittaker B.N. and Frith, R.C. (1990), Tunnelling: Design, Stability andConstruction, IMM
2) Ed. H. Wagner & A. Schulter (1996), Tunnel boring machines: Trends in design and construction of mechanized tunnelling, AAB **Reference Books:**
3) Nick Barton (2000), TBM tunnelling in jointed and faulted rock, AAB
4) B. Maidl, L. Schmid, W. Ritz and M. Herrenknecht, Wiley (2008), Hard rock tunnelboring machines