B. Tech with

HONORS

in

TUNNEL ENGINEERING

Academic Regulations, Course Structure and Syllabus

Effective from 2023-24 admitted batches

Offered by

Department of Civil Engineering

KSRM College of Engineering (A) – Kadapa

(Approved by AICTE, Accredited by NAAC with A+ Grade and NBA and Affiliated to JNTUA, Anantapuramu)

ELIGIBILITY / REGISTRATION / AWARD OF HONORS

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The program is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii) Those students with **at least 7.0 CGPA without any course backlogs up to III Semester in the major degree are only eligible to register for Honor degree**.

iii) A student shall earn **additional 18 credits for award of Honors** from same branch / department / discipline registered for major degree. This is in addition to 163 credits by a regular student and 123 Credits by a Lateral Entry student for the award of Major degree.

iv) A student is permitted to register for Honors in IV Semester after the results of III Semester are declared. Students shall register and pass in all the courses prescribed and being offered from V semester under the respective Honor degree.

v) Students have to attend classwork for courses under Honor degree beyond regular academic hours meant for major degree. Students can also undergo the courses under Honor through any proctored online platforms with the prior approval of the BoS Chairman and the HoD of the respective department offering Honor degree.

vi) The attendance for the registered courses under Honors and regular courses offered for Major degree in a Semester will be considered separately.

vii) A student shall have an aggregate of 75% attendance in all courses registered under Honors in that particular semester to become eligible for attending Semester-End examinations.

viii) The registration for the Honor will be cancelled, if the student is detained due to lack of attendance in Major,

ix) The registration for the Honor will be cancelled, if the student fails in any course of either Honor / Major in any semester from V to VIII Semester.

x) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) will be awarded for Honors degree program.

xi) A separate grade sheet will be issued for the Honor degree courses semester-wise.

xii) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra.

xiii) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical

Engineering.

xiv) There shall be a minimum enrolment of 20% OR 20 enrollments from the list of eligible students to offer Honors program.

xv) There is no fee for registration of courses for Honors program offered.

xvi) A student can register for either Minor / Honor but not both.

xvii) Student shall submit an application for either Minor / Honor at least one week before the commencement of the V Semester.

HONORS PROGRAMS OFFERED

Offering Department	Title	Who can Register
Civil Engineering	Civil Engineering	B.Tech. CE
	Tunnel Engineering	
	Interior Design	
Mechanical Engineering	Mechanical Engineering	B.Tech. ME
Electrical and Electronics Engineering	Electric Vehicles	B.Tech. EEE
Electronics and Communication Engineering	VLSI	B.Tech. ECE
	Embedded Systems and IoT	
Computer Science and Engineering	Computer Science and Engineering	B.Tech. CSE, B.Tech. AIML, B.Tech. CSE(DS), B.Tech. CSE(AIML)
	Artificial Intelligence and Machine Learning	
	Data Science	
	CSE-Artificial Intelligence and Machine Learning	

COURSE STRUCTURE

for

HONORS

in

TUNNEL ENGINEERING

S.No	COURSE CODE	COURSE TITLE	Semester Offered	L	T	P	IM	EM	CR
1	2301581H	Principles of Tunnel Engineering	V	3	0	0	30	70	3
2	2301582H	Underground Space Technology	V	3	0	0	30	70	3
3	2301681H	Rock Mechanics and Tunnelling	VI	3	0	0	30	70	3
4	2301682H	Fire Safety and Ventilation in Tunnels	VI	3	0	0	30	70	3
5	2301781H	Tunnel Construction Techniques	VII	3	0	0	30	70	3
6	2301782H	Applied Project Work	VII	0	0	6	60	140	3
Total				**15**	**0**	**6**	**210**	**490**	**18**

2301581H	HONORS IN TUNNEL ENGINEERING PRINCIPLES OF TUNNEL ENGINEERING (CE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Engineering Geology

Course Outcomes:

On successful completion of the course, student will be able to

CO1. classify different types of tunnels and select appropriate tunnelling methods based on geological conditions.
CO2. evaluate site investigation data and assess ground conditions for tunnel construction.
CO3. design primary and secondary support systems for tunnels using analytical and empirical methods.
CO4. compare and contrast different tunnelling methods and select optimal construction techniques
CO5. assess ventilation, lighting, drainage, and safety considerations in tunnels.

SYLLABUS:

UNIT - I: INTRODUCTION TO TUNNELING ENGINEERING (09 Periods)

Definition and purpose of tunnels, Historical development of tunnelling, Types of tunnels: Traffic tunnels, utility tunnels, mining tunnels, Classification based on purpose, location, and construction method, Tunnel geometry and cross-sectional shapes, Economic and environmental considerations, Case studies of major tunnel projects worldwide.

UNIT - II: GEOLOGY AND SITE INVESTIGATION (09 Periods)

Geological factors affecting tunnel construction, Rock mass classification systems (RMR, Q-system, GSI), Groundwater conditions and hydrogeology, Site investigation methods: Drilling, geophysical surveys, Laboratory and field-testing procedures, Geological hazards: Squeezing ground, swelling rock, gas emissions, Interpretation of geological data for tunnel design.

UNIT - III: TUNNEL DESIGN AND SUPPORT SYSTEMS (12 Periods)

Design philosophy and load considerations, Ground-structure interaction principles, Primary support systems: Rock bolts, shotcrete, steel sets, Secondary support: Concrete lining design, Analytical methods: Ground reaction curves, convergence-confinement, Numerical modelling techniques, Design of portals and approaches, Waterproofing and drainage systems.

UNIT - IV: TUNNELING METHODS AND CONSTRUCTION (10 Periods)

Conventional tunnelling methods: NATM, Cut and Cover, Mechanized tunnelling: TBM types and selection criteria, Shield tunnelling and EPB machines, Drill and blast techniques, Ground improvement methods, Construction sequence and cycle optimization, Quality control and construction monitoring, Special construction techniques for difficult ground.

UNIT - V: SAFETY, MONITORING, AND MODERN PRACTICES (08 Periods)

Tunnel lighting and ventilation systems, Fire safety, emergency systems, and escape routes, Tunnel collapses and case studies, Environmental impacts and mitigation.

Total Periods: 45

TEXT BOOKS:

T1. Tunnel Engineering Handbook**,** Thomas R. Kuesel, Elwyn H. King, and John O. Bickel (2nd Edition, Chapman & Hall/CRC, 2012)
T2. Tunnelling and Tunnel Mechanics, Dimitrios Kolymbas
T3. Rock Mechanics and Engineering, Xia-Ting Feng (CRC Press, 2017)

REFERENCE BOOKS:

R1. Modern Tunnelling Science and Technology, Bernard Maidl
R2. Tunnelling: Planning, Design, Construction, B. Singh & A.K. Goel
R3. IS Code: IS 5878 (Parts I-VI), Indian Standards for Tunnelling
R4. IRC: SP-91 Guidelines for Design and Construction of Road Tunnels

WEB RESOURCES:

1. https://nptel.ac.in/courses/105107208
2. https://nptel.ac.in/courses/105106055

2301582H	HONORS IN TUNNEL ENGINEERING UNDERGROUND SPACE TECHNOLOGY (CE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Engineering Geology

Course Outcomes:

On successful completion of the course, student will be able to

CO1. classify tunnels and describe their applications and alignment planning.
CO2. analyse the geotechnical investigations and methods used in tunnel construction
CO3. Compare excavation techniques in different ground conditions and tunneling methods.
CO4. evaluate tunnel support systems and equipment used.
CO5. assess ventilation, lighting, drainage, and safety considerations in tunnels.

SYLLABUS:

UNIT- I: INTRODUCTION (09 Periods)

Introduction to underground space and tunnelling, history, tunnelling challenges. Rock and rock mass behaviour, physico-mechanical properties, rock mass classification.

UNIT - II: EXCAVATION METHOD (09 Periods)

Principles of rock breakage, explosive energy, energy balance, blasting mechanism. Types of explosives, initiators, delay devices, primer and booster selection. Blast hole design. Drilling methods and machines Blast hole timing. Pattern design, open pit and underground blasting, production, estimation and damage criteria of ground vibrations.

UNIT - III: EXCAVATION MACHINERY (09 Periods)

TBM tunnelling. Factors influencing and evaluation, Excavation mechanics, Boom machines, transverse boom tunnelling machines and Robins mobile miner. Drag pick cutting, cutting tool materials and wear, disc cutters. Case studies.

UNIT - IV: FACILITY DESIGN (09 Periods)

Tunnels, energy storage caverns, nuclear waste disposal repositories, metros, underground chambers and defence installations. Geological considerations, layout, survey and alignment. Analysis and design methods. Construction methods.

UNIT - V: HAZARDS (09 Periods)

Safety provisions, localized hazards, fire hazards in highway tunnels, rapid transit tunnels. Surveillance and control system for highway tunnels. Tunnel finish.

Total Periods: 45

TEXT BOOKS:

T1. Underground excavations in Rock, Hoek, E. and Brown, E., CRC Press, 1980.
T2. Rock Blasting: Effects and Operations, P.P. Ray., 2005
T3. Engineering Rock Mechanics, Hudson and Harrison, 2012

REFERENCE BOOKS:

R1. Tunnel Boring Machines, Nick Barton, , 2000
R2. Rock Slope Engineering, Hoek, E. and Brady, J. D., Taylor and Francis, 1981
R3. Introduction to Tunnel Construction, D. Chapmann, N. Metje and A. Stark, Spon Press, 2010
R4. Tunnelling and Tunnel Mechanics, D. Kolymbas, Springer, 2005

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/105/107/105107216/
2. https://onlinecourses.nptel.ac.in/noc22_ce62/preview

2301681H	HONORS IN TUNNEL ENGINEERING ROCK MECHANICS AND TUNNELLING (CE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Engineering Geology

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Evaluate rock material properties and apply appropriate failure criteria for engineering analysis.
CO2. Determine in-situ stress conditions and classify rock masses using standard classification systems.
CO3. Analyze stability of underground openings using analytical and empirical methods.
CO4. Design appropriate support systems for tunnels and underground structures
CO5. Select optimal tunnelling methods and implement ground control strategies based on geological conditions.

SYLLABUS:

UNIT - I: FUNDAMENTALS OF ROCK MECHANICS (10 Periods)

Introduction to rock mechanics and its applications, Rock formation and geological processes, Physical properties of rocks: Density, porosity, permeability, Mechanical properties: Strength, deformability, durability, Laboratory testing methods: Uniaxial and triaxial compression tests, Tensile strength testing: Direct and indirect methods, Shear strength parameters and testing procedures, Anisotropy and scale effects in rock properties, Time-dependent behavior: Creep and fatigue.

UNIT - II: STRESS ANALYSIS AND ROCK MASS CHARACTERIZATION (09 Periods)

Stress and strain fundamentals in rock mechanics, Principal stresses and stress invariants, In-situ stress measurement techniques: Hydraulic fracturing, overcoring, Virgin stress estimation methods, Rock mass classification systems: RQD, RMR, Q-system, Geological Strength Index (GSI) method, Discontinuity characterization: Orientation, spacing, persistence, Joint roughness coefficient (JRC) and joint compressive strength (JCS), Rock mass strength and deformation parameters, Empirical correlations for rock mass properties.

UNIT - III: FAILURE CRITERIA AND STABILITY ANALYSIS (09 Periods)

Mohr-Coulomb failure criterion, Hoek-Brown failure criterion for intact rock and rock masses, Generalized Hoek-Brown criterion, Griffith theory and brittle fracture, Barton-Bandis criterion for rock joints, Slope stability analysis in rock masses, Wedge failure

and toppling analysis, Circular failure in weak rock masses, Numerical methods: Finite element and discrete element methods, Probabilistic approach to rock mass stability.

UNIT - IV: UNDERGROUND EXCAVATION AND SUPPORT DESIGN (09 Periods)

Stress distribution around circular and non-circular openings, Elastic solutions for underground excavations, Ground reaction curves and support interaction, Convergence-confinement method, Support system components: Rock bolts, shotcrete, steel sets, Systematic rock bolting design, New Austrian Tunnelling Method (NATM) principles, Observational method in tunnel design.

UNIT - V: TUNNEL METHODS (08 Periods)

Conventional tunnelling methods: Full face and sequential excavation, Mechanized tunnelling: TBM selection and operation, Drill and blast design for tunnelling, Ground improvement techniques: Grouting, freezing, dewatering, Tunnel Boring Machine (TBM) performance prediction, Cutter head design and disc cutter selection, Ground control in weak and fractured rock.

Total Periods: 45

TEXT BOOKS:

T1. Fundamentals of Rock Mechanics, J.C. Jaeger, N.G.W. Cook, and R.W. Zimmerman (4th Edition, Blackwell Publishing, 2007)
T2. Introduction to Rock Mechanics, Richard E. Goodman (2nd Edition, John Wiley & Sons, 1989)
T3. Practical Rock Engineering, Evert Hoek

REFERENCE BOOKS:

R1. Engineering Rock Mechanics, Hudson and Harrison, 2012
R2. Tunnel Boring Machines, Nick Barton, , 2000
R3. Rock Slope Engineering, Hoek, E. and Brady, J. D., Taylor and Francis, 1981
R4. Introduction to Tunnel Construction, D. Chapmann, N. Metje and A. Stark, Spon Press, 2010
R5. Tunnelling and Tunnel Mechanics, D.Kolymbas, Springer, 2005

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/105/107/105107216/
2. https://onlinecourses.nptel.ac.in/noc22_ce62/preview

2301682H	HONORS IN TUNNEL ENGINEERING FIRE SAFETY & VENTILATION IN TUNNELS (CE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Principles of Tunnel Engineering

Course Outcomes:

On successful completion of the course, student will be able to

CO1. analyse fire behaviour, heat release rates, and smoke propagation patterns in tunnel environments.
CO2. design ventilation systems for normal operation and emergency scenarios in different tunnel configurations.
CO3. implement fire detection, suppression, and evacuation systems for tunnel safety.
CO4. apply international fire safety standards and conduct risk assessments for tunnel projects.
CO5. integrate fire safety and ventilation systems with structural, mechanical, and electrical components.

SYLLABUS:

UNIT - I: FIRE DYNAMICS AND HEAT TRANSFER IN TUNNELS (09 Periods)

Introduction to tunnel fire safety and historical incidents, Fundamentals of combustion and fire dynamics, Heat release rate (HRR) and fire growth curves, Heat transfer mechanisms: Conduction, convection, and radiation, Temperature distribution in tunnel fires, Critical velocity and back layering phenomena, Fire plume characteristics in confined spaces, Ceiling jet behavior and smoke layer formation, Tunnel fire test methods and scaling laws, Computer modeling of tunnel fires (CFD applications)

UNIT - II: SMOKE MOVEMENT AND VENTILATION PRINCIPLES (09 Periods)

Smoke production and properties, Buoyancy-driven flows in tunnels, Stack effect and natural ventilation, Mechanical ventilation systems: Longitudinal, transverse, and semi-transverse, Jet fans and their applications, Ventilation during normal operation vs. emergency conditions, Smoke extraction systems and design principles, Pressure differentials and airflow control, Ventilation system capacity and redundancy, Energy efficiency in tunnel ventilation, Ventilation control strategies and automation

UNIT - III: FIRE DETECTION AND SUPPRESSION SYSTEMS (09 Periods)

Fire detection technologies: Heat, smoke, and flame detectors, Linear heat detection systems, Video fire detection and CCTV monitoring, Automatic fire suppression systems: Water mist, foam, and gas systems, Sprinkler systems design for tunnels, Deluge systems and water curtains, Fixed firefighting systems (FFFS), Portable fire extinguishing equipment, Fire detection system integration and control, Maintenance and testing of fire safety systems, Performance-based design approaches, Case studies of fire suppression system failures and successes

UNIT - IV: EMERGENCY MANAGEMENT AND EVACUATION (09 Periods)

Emergency response planning and procedures, Evacuation strategies and egress design, Emergency lighting and signage systems, Communication systems for emergency situations, Public address and emergency broadcasting, Refuge areas and safe havens, Emergency services access and firefighting operations, Tunnel closure and traffic management during emergencies, Emergency drills and training programs, Incident command systems, Post-incident analysis and lessons learned, Human behavior in tunnel emergencies, Emergency response coordination between agencies

UNIT - V: CODES, STANDARDS, AND RISK ASSESSMENT (09 Periods)

International fire safety standards: NFPA, ITA, and regional codes, Design fire scenarios and safety requirements, Quantitative risk assessment (QRA) methodologies, Fire safety engineering principles, Life safety and property protection objectives, Acceptable risk criteria and safety targets, Cost-benefit analysis of fire safety measures, Fire safety management during construction and operation, Regular inspection and maintenance protocols, Performance monitoring and system optimization, Emerging technologies in tunnel fire safety, Integration with intelligent transportation systems (ITS), Climate change considerations and resilience planning, Case studies of major tunnel fire incidents worldwide.

Total Periods: 45

TEXT BOOKS:

T1. Tunnel Fire Safety, Haukur Ingason, Ying Zhen Li, and Anders Lönnermark (Springer, 2015)
T2. Handbook of Tunnel Fire Safety, Alan Beard and Richard Carvel (2nd Edition, ICE Publishing, 2012)
T3. Fire Safety in Tunnels, PIARC Technical Committee on Road Tunnels (PIARC, 2008)

REFERENCE BOOKS:

R1. Fire Safety in Underground Transportation Systems, Sergey Dorofeev (Elsevier, 2019)
R2. Fire Safety Engineering Design of Structures" by John A. Purkiss and Li-Yang Li (3rd Edition, CRC Press, 2013)
R3. Fire Dynamics, Dougal Drysdale (3rd Edition, John Wiley & Sons, 2011)

R4. Guidelines for Design of Tunnels, International Tunnelling Association (ITA, 2019)

WEB RESOURCES:

1. https://nptel.ac.in/courses/105102176
2. https://onlinecourses.nptel.ac.in/noc20_ce09/preview

2301781H	HONORS IN TUNNEL ENGINEERING TUNNEL CONSTRUCTION TECHNIQUES (CE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Principles of Tunnel Engineering

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Select appropriate tunnel construction methods based on geological, geometric, and economic factors

CO2. Design and execute conventional tunneling operations including excavation cycles and support installation

CO3. evaluate TBM types, optimize performance parameters, and manage mechanized tunneling operations.

CO4. apply ground improvement techniques and specialized methods for difficult tunneling conditions.

CO5. develop comprehensive construction plans with safety management and quality assurance protocols

SYLLABUS:

UNIT - I: FUNDAMENTALS OF TUNNEL CONSTRUCTION (09 Periods)

Introduction to tunnel construction methods and classification, Factors affecting construction method selection, Geological and geotechnical considerations, Geometric constraints and alignment considerations, Environmental and regulatory factors, Economic analysis and cost estimation, Risk assessment in tunnel construction, Project delivery methods: Design-bid-build, design-build, PPP Construction planning and scheduling, Site investigation and ground characterization, Contract strategies and procurement methods, Stakeholder management and public consultation

UNIT - II: SMOKE MOVEMENT AND VENTILATION PRINCIPLES (09 Periods)

Smoke production and properties, Buoyancy-driven flows in tunnels, Stack effect and natural ventilation, Mechanical ventilation systems: Longitudinal, transverse, and semi-transverse, Jet fans and their applications, Ventilation during normal operation vs. emergency conditions, Smoke extraction systems and design principles, Pressure differentials and airflow control, Ventilation system capacity and redundancy, Energy efficiency in tunnel ventilation, Ventilation control strategies and automation

UNIT - III: FIRE DETECTION AND SUPPRESSION SYSTEMS (09 Periods)

Fire detection technologies: Heat, smoke, and flame detectors, Linear heat detection systems, Video fire detection and CCTV monitoring, Automatic fire suppression systems: Water mist, foam, and gas systems, Sprinkler systems design for tunnels, Deluge systems and water curtains, Fixed firefighting systems (FFFS), Portable fire extinguishing equipment, Fire detection system integration and control, Maintenance and testing of fire safety systems, Performance-based design approaches, Case studies of fire suppression system failures and successes

UNIT- IV: EMERGENCY MANAGEMENT AND EVACUATION (09 Periods)

Emergency response planning and procedures, Evacuation strategies and egress design, Emergency lighting and signage systems, Communication systems for emergency situations, Public address and emergency broadcasting, Refuge areas and safe havens, Emergency services access and firefighting operations, Tunnel closure and traffic management during emergencies, Emergency drills and training programs, Incident command systems, Post-incident analysis and lessons learned, Human behavior in tunnel emergencies, Emergency response coordination between agencies

UNIT- V: CONSTRUCTION MANAGEMENT AND QUALITY CONTROL (09 Periods)

Construction planning and project management, Resource allocation and scheduling, Construction equipment selection and management, Health and safety management systems, Risk management and contingency planning, Quality assurance and quality control, Materials testing and acceptance criteria, Construction monitoring and instrumentation, Progress tracking and reporting, Cost control and change management, Environmental management and sustainability, Waste management and material recycling, Commissioning and handover procedures, Performance monitoring and post-construction evaluation, Maintenance planning and asset management, Lessons learned and continuous improvement

Total Periods: 45

TEXT BOOKS:

T1. Mechanized Tunnelling in Urban Areas, Vittorio Guglielmetti, Piergiorgio Grasso, and Ashraf Mahtab (2nd Edition, CRC Press, 2015)
T2. Tunnel Construction, Szechy (Springer-Verlag, 1973)
T3. Tunneling: Design, Stability, and Construction, Cesar Sagaseta and A. Whittle (CRC Press, 2019)

REFERENCE BOOKS:

R1. Tunnel Boring Machines: Trends in Design & Construction of Mechanized Tunnelling, Bernhard Maidl (Ernst & Sohn, 2019)
R2. Construction Planning and Management, P.S. Gahlot and Dhir Dhir (New Age International, 2016)
R3. Introduction to Tunnel Construction, David Chapman, Nicole Metje, and Alfred Stärk (CRC Press, 2018

WEB RESOURCES:

1. https://nptel.ac.in/courses/105102176
2. https://onlinecourses.nptel.ac.in/noc20_ce09/preview

2301782H	HONORS IN TUNNEL ENGINEERING APPLIED PROJECT WORK (CE)	L	T	P	C
		0	0	6	3

Pre-Requisites: Basic knowledge in the respective engineering department/section

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Apply core engineering knowledge to identify and define a suitable project topic in the field of civil engineering.
CO2. Analyze project requirements and constraints to formulate clear objectives and specifications.
CO3. Develop and execute a project plan using appropriate conventional techniques and modern engineering tools.
CO4. Demonstrate professional skills and confidence to undertake independent or team-based engineering tasks effectively.
CO5. Prepare and present comprehensive technical documentation and communicate project findings clearly and professionally.

The Honors Degree Project Work in Tunnel Engineering is a comprehensive and application-focused component undertaken during the eighth semester. It provides students with the opportunity to apply theoretical knowledge and practical expertise to real-world problems through a design-based, experimental, field surveying, or computer-aided project in Tunnel Engineering or related domains. Students will work in groups under the guidance of a faculty supervisor. The internal evaluation will be carried out through three progress seminars, assessed by a departmental review committee. For each review, students must submit a typed report (ranging from six to ten pages) summarizing the progress made. The final assessment will be conducted by a committee comprising both internal and external faculty members with expertise in Tunnel Engineering and related fields. Each group will present their completed project work to the evaluation panel for external review. Upon completion, the final project report, duly signed by the project guide, must be submitted. The Head of the Department will verify and certify the reports. Students are required to submit three hard copies of the final report: one copy to the faculty guide, one to the departmental library, and one to the central college library. This project work aims to enhance students' ability to solve complex tunnel engineering problems, design efficient and safe underground solutions, manage project execution, and communicate their technical findings effectively.