

Pimpri Chinchwad Education Trust's
PIMPRI CHINCHWAD COLLEGE OF ENGINEERING
SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune



Effective from Academic Year 2026-27
Updated With Minor Changes

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value-Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with ability to think and act independently in demanding situations

EOMS Policy

“We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute’s social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS).”

Course Approval Summary

Board of Studies - Department of Civil Engineering

Sr. No.	Name of the Course	Course Code (Scheme)	Sem	Page number	Signature and stamp of BoS chairman
1	Introduction to Metro Engineering	BCI25HN01	V	10	 13/5/26 Chairman BoS, Civil Engineering PCET's, Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
2	Metro Transportation Lab	BCI25HN02	V	12	
3	Design of Metro	BCI26HN03	VI	14	
4	Railway and Metro Alignment Design Lab	BCI26HN04	VI	16	
5	Metro: Operations and Implementation	BCI27HN05 (A)	VII	19	
6	Seminar	BCI27HN06 (A)	VII	21	
7	Mini Project	BCI27HN07 (B)	VII	22	
8	Mini Project	BCI28HN08 (A)	VIII	24	
9	Metro: Operations and Implementation	BCI28HN09 (B)	VIII	25	
10	Seminar	BCI28HN10 (B)	VIII	27	

Approved by Academic Council:


Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

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3	Design of Metro	BCI26HN03	VI	14	
4	Railway and Metro Alignment Design Lab	BCI26HN04	VI	16	
5	Metro: Operations and Implementation	BCI27HN05 (A)	VII	19	
6	Seminar	BCI27HN06 (A)	VII	21	
7	Mini Project	BCI27HN07 (B)	VII	22	
8	Mini Project	BCI28HN08 (A)	VIII	24	
9	Metro: Operations and Implementation	BCI28HN09 (B)	VIII	25	
10	Seminar	BCI28HN10 (B)	VIII	27	

Approved by Academic Council:

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

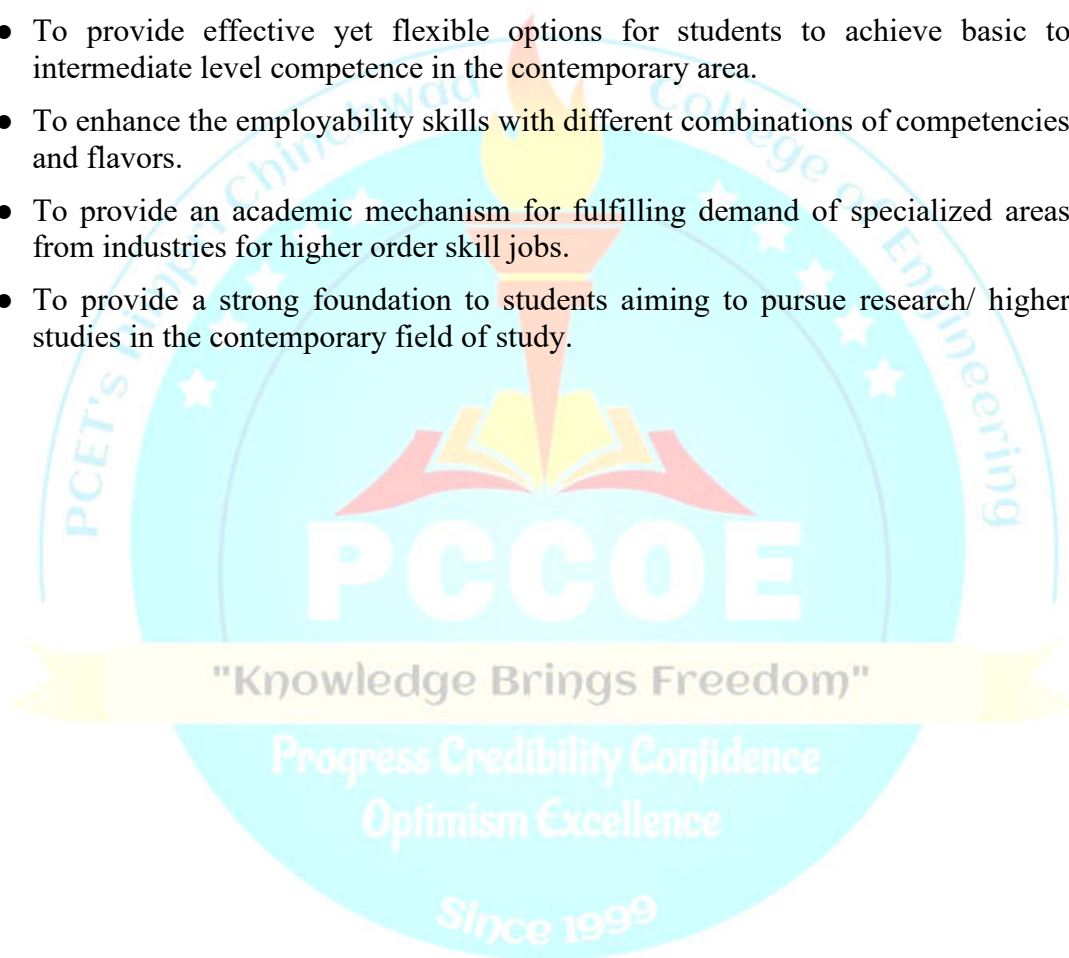
Preface

Looking at Global Scenario to enhance the employability skills and impart deep knowledge in emerging/ multidisciplinary areas, an additional avenue is provided to passionate learners through the Minors and Honors Degree Scheme in academic structure.

For the Honors degree program, students have to earn additional 20 credits in an emerging area of one's own domain.

Objectives of Honors Degree

- To enable students to pursue allied academic interest in contemporary areas.
- To provide effective yet flexible options for students to achieve basic to intermediate level competence in the contemporary area.
- To enhance the employability skills with different combinations of competencies and flavors.
- To provide an academic mechanism for fulfilling demand of specialized areas from industries for higher order skill jobs.
- To provide a strong foundation to students aiming to pursue research/ higher studies in the contemporary field of study.



Preface of Honor in Metro Transportation System

Public transportation systems include a variety of transit options such as buses, light rail, metro and subways. These systems are available to the general public, may require a fare, and run at scheduled times. The purpose of introducing or expanding public transportation is to increase access to and use of public transit while, at the same time, reducing motor vehicle miles driven and traffic congestion. Metro Transportation System aims in providing the technical knowledge and understanding in the domain of Mass Rapid Transit System. Honors in Metro Transportation Systems will certainly help the students to bring the modern tools and techniques in implementing strategies by serving the society with the best public transportation system. This course will help students to foster the technical needs with the community benefits. This course is blended with on ground practices and industrial approaches.

Honors in Metro Transportation Systems helps students in developing technical and interrogative skills to manage the evolving threat landscape through well formulated curriculum that stimulates hands-on learning. Metro Transportation System Honors Program offered by the Department of Civil Engineering helps students to attain qualitative competencies in the overall development of Metro Rail Transit System.

Learning Objectives

This Course Aims

- Impart knowledge of metro construction and impart the fundamentals of LRT system
- Build facts related to metro development in India and at global level.
- Understand the alignments and land utilizations for mass transport development
- Identify the signal arrangement and its functions for the smooth operations of Metro
- Impart the construction techniques of at grade and grade separators geometrical features.

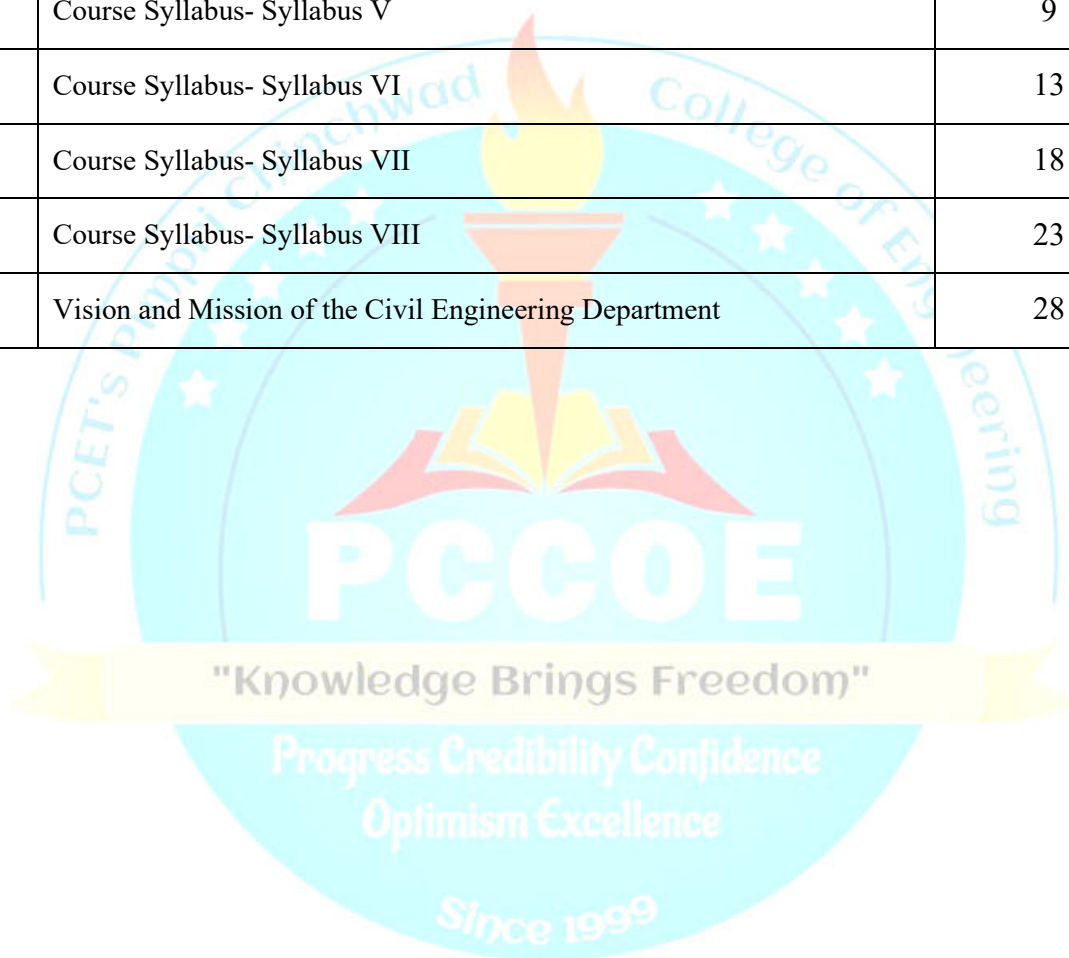
Learning Outcomes

After the successful completion of the honor course, students will be

- Appreciate the importance of different modes of transportation and characterize rail transportation.
- Alignment and geometry of urban metro rail according to topography.
- Assess the properties of rail alignment and design of curves
- Understand the importance of railway infrastructure planning and design.
- Identify the functions of different components of railway track.

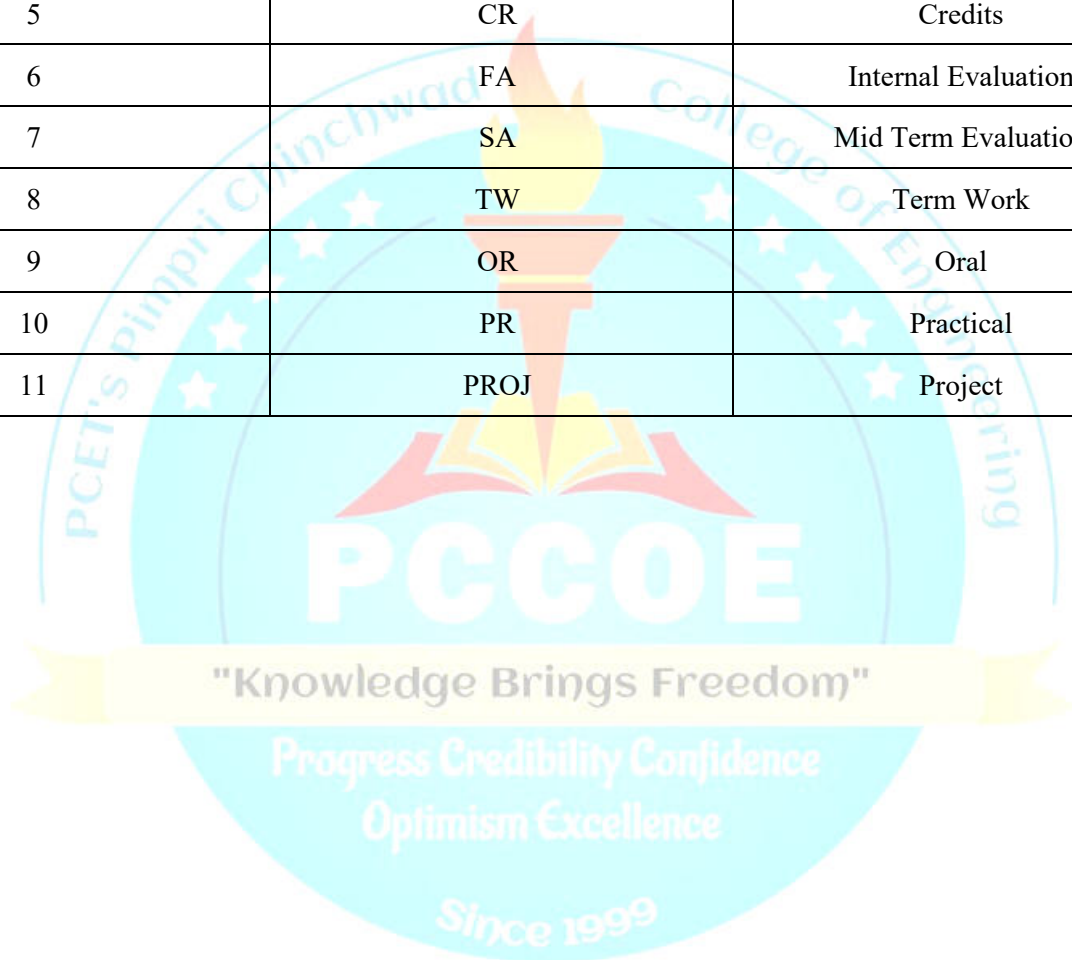
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LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

Sl. No	Abbreviation	Expansion
1	L	Lecture
2	P	Practical
3	T	Tutorial
4	H	Hours
5	CR	Credits
6	FA	Internal Evaluation
7	SA	Mid Term Evaluation
8	TW	Term Work
9	OR	Oral
10	PR	Practical
11	PROJ	Project



CURRICULUM STRUCTURE**For Honors in Metro Transportation System (Civil Engineering)**

Scheme A														
Semester	Course Codes	Course Name	Teaching Scheme				CR	Evaluation Scheme and Marks						
			L	P	T	H		FA1	FA2	SA	TW	PR	OR	Total
V	BCI25HN01	Introduction to Metro Engineering	3	-	-	3	3	20	20	60	-	-	-	100
V	BCI25HN02	Metro Transportation Lab	-	2	-	2	1	-	-	-	-	-	25	25
VI	BCI26HN03	Design of Metro	3	-	-	3	3	20	20	60	-	-	-	100
VI	BCI26HN04	Railway and Metro Alignment Design Lab	-	2	-	2	1	-	-	-	25	-	-	25
VII	BCI27HN05	Metro: Operations and Implementation	3	-	-	3	3	20	20	60	-	-	-	100
VII	BCI27HN06	Seminar	-	4	-	4	2	-	-	-	30	-	20	50
VIII	BCI28HN08	Mini Project	-	10	-	10	5	-	-	-	75	-	50	125
Total			9	18	-	27	18	60	60	180	130	-	95	525

Scheme B														
Semester	Course Codes	Course Name	Teaching Scheme				CR	Evaluation Scheme and Marks						
			L	P	T	H		FA1	FA2	SA	TW	PR	OR	Total
V	BCI25HN01	Introduction to Metro Engineering	3	-	-	3	3	20	20	60	-	-	-	100
V	BCI25HN02	Metro Transportation Lab	-	2	-	2	1	-	-	-	-	-	25	25
VI	BCI26HN03	Design of Metro	3	-	-	3	3	20	20	60	-	-	-	100
VI	BCI26HN04	Railway and Metro Alignment Design Lab	-	2	-	2	1	-	-	-	25	-	-	25
VII	BCI27HN07	Mini Project	-	10	-	10	5	-	-	-	75	-	50	125
VIII	BCI28HN09	Metro: Operations and Implementation	3	-	-	3	3	20	20	60	-	-	-	100
VIII	BCI28HN10	Seminar	-	4	-	4	2	-	-	-	30	-	20	50
Total			9	18	-	27	18	60	60	180	130	-	95	525

L- Lecture, T- Tutorial, P- Practical, H-Hours, CR- Credit, FA – Formative Assessment, SA –Summative Assessment, TW – Term Work, PR- Practical Exam, OR – Oral Exam

Course syllabus
Semester-V
Honors in
Metro Transportation System

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	V		
Course:	Introduction to Metro Engineering			Code:	BCI25HN01		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
3	3	-	-	20	20	60	100

Prior-Knowledge: Basics of Transportation Engineering-modes of transportation- importance of railway engineering

Course Objectives:

- 1 To impart knowledge of metro construction and impart the fundamentals of LRT system
- 2 To build facts related to metro development in India and at global level.
- 3 To understand the alignments and land utilizations for mass transport development

Course Outcomes:

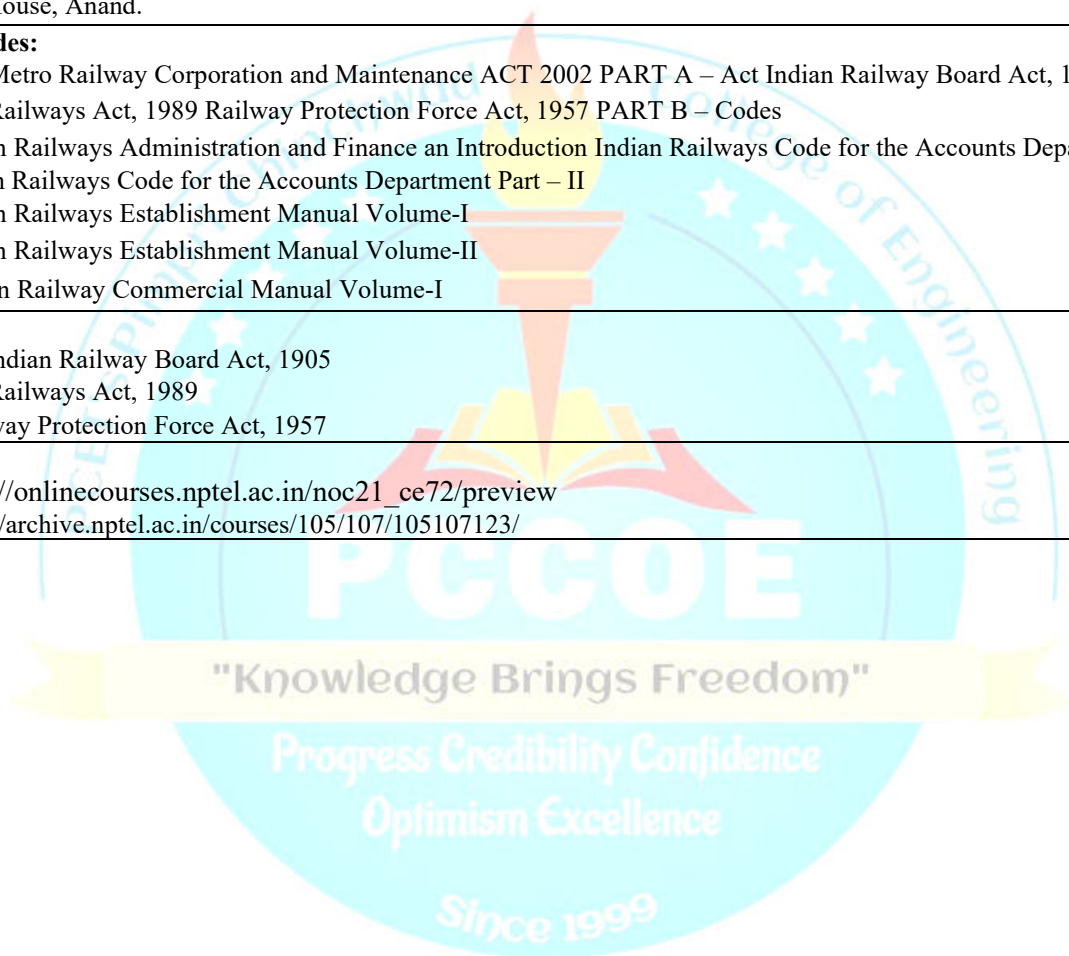
After learning the course, the students should be able to:

- 1 Appreciate the importance of different modes of transportation and characterize the rail transportation.
- 2 Alignment and geometry of urban metro rail according to topography.
- 3 Assess the properties of rail alignment and design of curves
- 4 Understand the importance of railway infrastructure planning and design.
- 5 Identify the functions of different component of railway track.

Detailed Syllabus

Unit	Description	Duration (H)
1	Basics of metro development in India and at global level Origin of railways and metro, Development of metro in Indian metropolitan cities, Rail transit development in foreign countries, Various organizations working for the development of metro rail transit system and vision of the governing bodies behind the development	9
2	Engineering surveys for metro construction Engineering surveys importance-necessity and types Engineering Surveys and Construction of Metro Railway Need for Construction of a New Metro Railway Lines, Preliminary Investigations for a Metro Railway, Traffic Survey, Reconnaissance Survey, Preliminary Survey, Preliminary Engineering-cum-traffic Survey, Final Location Survey, Modern Surveying Techniques for Difficult Terrain, Construction of New Lines of Metro Railway Required Drainage surveys	9
3	Alignment and land utilization for urban metro rail Introduction to urban transportation system, Land use zoning and planning, the transportation Study area definition; division into traffic zones network identification and coding Design of horizontal and vertical alignment, Track recording car and track parameters in terms of alignment, unevenness, twist, cross level gauge. Curved track- classification of curves, measurement of radius transition curve, true curve, super elevation on curves, cant deficiency, movement of vehicles on curves, speed on curves, check rails, gauge widening on curves, gradient /vertical curves	9
4	Design of obligatory points for the metro construction Obligatory points-plan design and construction Mass transit and intermediate public transport surveys; sampling and expansion factors; accuracy checks, screen line checks, consistency checks Urban forms and structures: point, linear, radial, poly-nuclear developments and suitable transit systems, Design principles of bridges and culverts	9
5	Technology enhancement in the field of Metro construction at global level Case studies for the development done in metros, rail transit operation (Light rail transit, Metro, Mono rail, urban rails) at global and Indian level. Similar technology development (alternatives)-TRAM, Skybus, Electric Bus, Subways etc. Investigations for Important Bridges, Design Flood Discharge for bridges	9
Total		45

Self-Learning: History of Metro Development in Developed, Developing Nations	
Text Books:	
1.	Metro Rail Projects in India: A Study in Project Planning Book by M. Ramachandran, First Edition 2011, Oxford University Press, New Delhi
2.	Excellence in Metro Operations and Management: Best practices world over by Sharat Sharma, Amit kumar Jain and Sankalp Devendra, First Edition (2023), PHI Learning, New Delhi.
3.	R K Goel, B Singh and J Zhao, Underground Infrastructures: Planning, Design and Construction, Butterworth-Heinemann, Oxford, 2012.
Reference Books:	
1.	Satish Chandra and M.M. Agrawal, Railway Engineering, Second Edition, 2013, Oxford University Press, New Delhi,
2.	S.C. Saxena and S. P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, New Delhi, 2013
3.	S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, 27th Edition (2017), Charotar Publishing House, Anand.
Standard Codes:	
1.	The Metro Railway Corporation and Maintenance ACT 2002 PART A – Act Indian Railway Board Act, 1905
2.	The Railways Act, 1989 Railway Protection Force Act, 1957 PART B – Codes
3.	Indian Railways Administration and Finance an Introduction Indian Railways Code for the Accounts Department.
4.	Indian Railways Code for the Accounts Department Part – II
5.	Indian Railways Establishment Manual Volume-I
6.	Indian Railways Establishment Manual Volume-II
7.	Indian Railway Commercial Manual Volume-I
Acts:	
1.	Act Indian Railway Board Act, 1905
2.	The Railways Act, 1989
3.	Railway Protection Force Act, 1957
e-Resources	
1.	https://onlinecourses.nptel.ac.in/noc21_ce72/preview
2.	https://archive.nptel.ac.in/courses/105/107/105107123/



Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	V		
Course:	Metro Transportation Lab			Code:	BCI25HN02		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	-	25	-	25

Prior Knowledge: Basics of Transportation Engineering-modes of transportation- importance of railway engineering

Objectives:

1. To Impart the practical skill set to learn the aspects of rail-based transportation system
2. To create understanding regarding the various surveys required for the rail-based mass transport system planning

Outcomes:

After learning the course, the students should be able to:

1. Identify the different types of rail section
2. Perform the traffic survey required for metro transport/mass transport system planning
3. Identify the interchange location and study area
4. Create the Feasibility report related to the development of metro systems

Detailed Syllabus: (Any Seven)

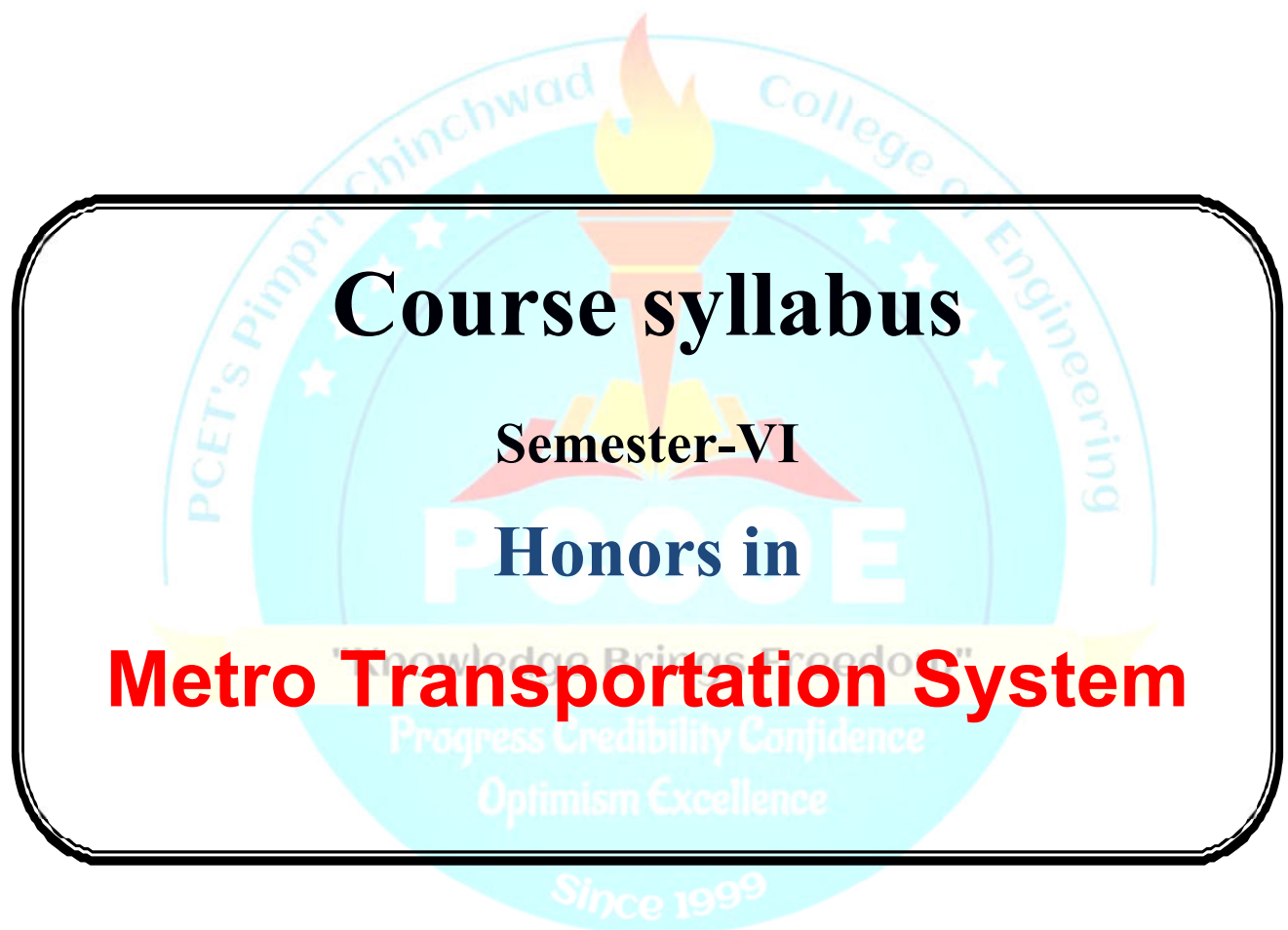
1. Assignment on Rail Wheel Interaction, Track elements, 90 R, 52 Kg, 60 Kg Flat Bottom Rail, Bull Head Rail, Cast Iron Chair, Rail Screws, Base Plate, Insulating Pad
2. Traffic Survey for vehicle fleet count
3. Road User preference survey
4. Multimodal Interchange location survey
5. On board survey for delay measurement
6. Visit to a metro or monorail or LRT
7. Assignment based on a Case study of Delhi Metro-Mumbai Metro, Bangalore Metro, Pune Metro
8. A Review presentation on detailed project report of any mass transport system
9. A Seminar presentation on Development of Metro in India.
10. A Short report based on individual travel experience in multiple modes of transit system

Reference Books:

1. Traffic Engineering and Transport Planning by Dr.L.R.Kadiyali,9th Edition(1999) Khanna Publishers, New Delhi
2. S.C. Saxena and S. P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, New Delhi,2013
3. S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, 27th Edition (2017), Charotar Publishing House, Anand

E-Resources

- 1 https://onlinecourses.nptel.ac.in/noc21_ce72/preview
- 2 <https://archive.nptel.ac.in/courses/105/107/105107123/>



Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VI		
Course:	Design of Metro			Code:	BCI26HN03		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
3	3	-	-	20	20	60	100
Prior-Knowledge: Basics of Transportation Engineering-modes of transportation- importance of railway engineering							
Objectives: 1. To impart knowledge of metro construction and impart the fundamentals of LRT system 2. To build the geometrical features of a metro rails 3. To understand the signal arrangement and its functions							
Outcomes: After learning the course, the students should be able to: 1. Analyze the track stresses and will be able to proposes a design of a rail track 2. Understand the importance and functionality of turnout and crossing 3. Execute the design of obligatory points and curves for the metro 4. Learn the electrification of metro trains in brief 5. Sensitize the codal provisions and various acts related to development of metro in India							
Detailed Syllabus:							
Unit	Description						Duration (Hrs.)
1 .	Track Designing and Track stresses a) Requirements of a Good Track, Maintenance of Permanent Way, Track as an Elastic Structure, Forces Acting on the Track Tunnel Railways b) Types of station, site selection and requirements for a railway station and yards						9
2.	Turnouts and Crossings a) Turnouts and Crossings — Components constituting turnouts and crossings, various turnouts like 1 in 8 1/2, 1 in 12, 1 in 20 etc. Slip points, operation of turnouts mechanical & electrical, locking of turnout b) Types of crossing, Merits & demerits, crossing clearance, special fitting with turnouts and combination of points and crossing, differentiate between Left and Right hand Turn Out,Case stud on any one crossing in India						9
3 .	Geometric Design of components and features for the development of metro a) Obligatory points- needs importance and construction b) Geometric design of railway track: gradients, grade compensation c) Speed of trains on curves, super elevation, cant deficiency, negative super elevation, d) Curves, widening on curves. e) Formation, Gauge, type of rails, sleepers, rail joiners, rail & sleeper fasteners, special joints, insulated joints, expansion allowance and expansion joints, check rails, sleeper spacing, short welded rails (SWR), long welded rails (LWR) & continuous welded rails (CWR), ballast						9
4 .	Metro electrification (introduction) and signal designing a) Different types of signaling systems (historic), Semaphore (Lower & Upper Quadrant) mechanical signals, Multiple Aspect Colour Light Signals b) Track circuits – Train detection (occupancy of track) Panel Interlocking signaling system, Route Relay Interlocking (RRI) system, Electronic Interlocking Axle counters c) Principle and Methods of Interlocking and Devices used for interlocking						8

5 .	Metro act and codal provisions a) Introduction of metro act, Report of Ministry of Urban Development on standardization of metro system. b) Metro Policy 2017 c) Comprehensive City Mobility Plan (CCMP) d) Alternatives analysis report (AAR) e) Detailed Project Report (DPR)	10
	Total	45
Self Learning: Advancements in AI for Railway Tract Design		
Text Books: 1) S.C. Saxena and S. P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, New Delhi, 2013. 2) S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, 27th Edition (2017), Charotar Publishing House, Anand 3) Satish Chandra and M.M. Agrawal, Railway Engineering, Second Edition, 2013, Oxford University Press, New Delhi. 4) Cut and Cover Metro structures. by Kaul Krishan, CBC Press, New Delhi, first edition (2010).		
Reference Books: 1) Indian Railways Permanent Way Manual Published by Indian Railways corrected up to 2004 2) Developments In High-Speed Track Design 1994 By Professor in Railway Engineering Delft University of Technology Delft, The Netherlands 3) Notes on Curves for Railways by Prof V B Sood, Indian Railways Institute of Civil Engineering Pune		
Standard Code: 1) Indian Railways Establishment Manual Volume-I 2) Indian Railways Establishment Manual Volume-II 3) Indian Railway Commercial Manual Volume-I		
Acts: 1) The Metro Railway Corporation and Maintenance ACT 2002 PART A – Act Indian Railway Board Act, 1905 2) The Railways Act, 1989 Railway Protection Force Act, 1957 PART B – Codes 3) Indian Railways Administration and Finance an Introduction Indian Railways Code for the Accounts Dept. Part - I 4) Indian Railways Code for the Accounts Department Part – II		

"Knowledge Brings Freedom"

Progress Credibility Confidence
Optimism Excellence

Since 1999

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VI		
Course:	Railway and Metro Alignment Design Lab			Code:	BCI25HN04		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	25	-	-	25

Prior Knowledge:

Course Objectives:

To introduce the students with various features of Bentley's Open Rail Designer.

Course Outcomes:

After learning the course, the students should be able to:

1. Develop basic railway and metro track alignment and layouts
2. Develop horizontal and vertical alignments for railway/ metro corridors

Detailed Syllabus

1. Familiarization with Rail Design Software Environment

Launch and configure rail design software (OpenRail Designer / equivalent), Explore interface, toolsets, and workspaces related to rail/metro projects, create a new rail project and define working units and standards, Create and manage track feature definitions and symbology, Attach and reference base map, survey data, and alignment files

2. Terrain Modeling for Railway / Metro Corridor

Import terrain data (survey / DTM) for rail corridor, Display and analyze terrain in plan and 3D view, Reference a 3D terrain model into a 2D design file, Create and analyze terrain profiles along proposed rail alignment, Label and verify terrain points relevant to rail design

3. Horizontal and Vertical Geometry Design for Rail Track

Create horizontal alignment using tangents, circular curves, and transition curves, Define chainage/stationing and apply annotations, Generate existing ground profile along alignment, Design vertical profile considering gradients and vertical curves, Review and modify alignment in 2D and 3D views

4. Track Layout and Corridor Modeling for Rail / Metro Systems

Create single and double track layouts, Model basic track components (rail, sleeper, ballast, formation), Design turnouts and crossovers (introductory level), Create metro-specific elements such as platform alignment and station zone, Generate basic corridor model and check clearances

Reference Books:

1. Guerrieri, M. (2023). Fundamentals of railway design. Springer.
2. Mundrey, J. S. (2009). Railway track engineering. Tata McGraw-Hill Education.
3. V. B. Sood (2022). Railway Curves. Indian Railways Institute of Civil Engg.
4. N. K. Mishra (2019). Curve Layouts. Indian Railways Institute of Civil Engg.

E-Resources

- 1 Rail Design & Modeling – Fundamentals Learning Path.
<https://learning.bentley.com/learn/learning-plans/615/bentley-accredited-road-designer:-road-design-modeling-with-openroads-designer>
- 2 OpenRail Onboarding guide.
https://www.bentley.com/wp-content/uploads/openroads_designer_onboarding_guide_v1.1.pdf



Course syllabus
Semester-VII
Honors in
Metro Transportation System

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VII (Scheme A)		
Course:	Metro: Operations and Implementation			Code:	BCI27HN05		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
3	3	-	-	20	20	60	100
Prior-Knowledge: 1 Basics of Transportation Engineering-modes of transportation- importance of railway engineering							
Objectives: 1. To impart knowledge of metro operations and fleet management 2. To evaluate the financial feasibility of a metro project 3. To understand the impacts of metro development on environments and relative aspects 4. To impart the knowledge related to estimation and contracting process for metro project							
Outcomes: After learning the course, the students should be able to: 1. Understand the operations and functions of metros 2. Apply logic to understand the concept for the sustainable development for mass transport development 3. Evaluate the economic and financial feasibility of a metro project 4. Perform the estimation and costing of a metro project 5. Understand various methods and techniques available for the repairs and maintenance							
Detailed Syllabus:							
Unit	Description						Duration (H)
1 .	Metro Operations, Fleet Management and passenger information system Operations of Metro Passenger information and ticketing system Fleet management as per the travel demand Design of interchange locations Public-para, para-public transport corridor development						9
2	Environmental Impact assessment of metro Sustainability issues in Urban areas Central pollution control board and state pollution control board guidelines Urban and non-urban traffic noise sources, Noise level factors, Effects of traffic noise, Measurement and prediction, Control measures, Noise studies, Noise standards, Road transport related air pollution, Sources of air pollution, Effects of weather conditions, Vehicular emission parameters, Pollution standards, Measurement and analysis of vehicular emission, Mitigative measures. EIA requirements of highway projects, Procedures, MOEF/World Bank/IRC/UK Guidelines, EIA practices in India.						9
3 .	Economical and financial evaluation of a metro project Economic and Financial analysis of a metro project- case studies of mumbai, pune metro rails systems Types of Appraisals such as Political, Social, Environmental, Techno-Legal, Financial and Economical, Criteria for Project Selection - Benefit - Cost Analysis, NPV, IRR, Pay-Back Period, Break Even Analysis [Fundamental and Application Component], Study of Project Feasibility report and Detailed Project Report (DPR), Role of Project Management Consultants						9
4 .	Estimation, Tendering and Contracting in Metro systems Tender procedure for Metro project Definition of estimation and valuation. Significance (application) of the Course. Purpose of estimation. Type of estimates, data required for estimation as a prerequisite. Meaning of an item of work, and enlisting the items of work for different Civil Engineering projects. Units of measurement. Mode of measurement of building items/ works. Introduction to components of estimates: face sheet, abstract sheet (BOQ), measurement sheet, Rate Analysis, lead statement. Provisional sum & prime cost items, contingencies, work charged establishment, centage charges. Introduction to D. S. R						9

5 .	Repairs, Rehabilitation and Maintenance Repairing techniques for the metros, Regular-periodic and special maintenance measures Advancement in the area of repairs and maintenance, Reasons of failures of metro structures, Case studies based on various metro failures	9
	Total	45
Self-Learning: Case study on Pune Metro Economical and financial evaluation.		
Text Books: 1. Kadiyali L.R.Traffic Engineering & Transport Planning.KhannaPublications,2013. 2. KhistyC.J.and Lall B.K.Transportation Engineering–An Introduction.3rd Edition,Pearson,2017. 3. Estimating and Costing in Civil Engineering: Theory and Practice: B.N Dutta - S. Dutta & Company, Lucknow. (2016) 4. Estimating and Costing: R. C. Rangwala, 18th Edition, Charotar Publ. House, Anand (2023) 5. Taylor MAP and Young W, "Traffic Analysis – New Technology and New Solutions", Hargreen Publishing Company, 1998		
Reference Books: 1. Canter L. Environmental Impact Assessment, McGraw Hill.(2012) 2. Kiely G. Environmental Engineering, Tata McGraw Hill.(2007) 3. Rau G.J. and Wooten C.D. Environmental Impact Analysis Handbook, McGraw Hill (1980) 4. Dhameja S.K. Environmental Engineering and Management, S. K. Kataria& Sons.MoEF Guidelines and amendments as updated on http://moef.gov.in 5. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia 6. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill 7. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publisher s		
Standard Code: 1. Acts Related to Minimum Wages, Workmen’s Compensation, Contract, and Arbitration 2. Typical PWD Rate Analysis documents		

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Optimism Excellence

Since 1999

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VII (Scheme A)		
Course:	Seminar			Code:	BCI27HN06		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	30	20	-	50
Objectives: 1. To work on a specific technical topic in metro transportation systems, in order to acquire the skills for technical communication. 2. To acquire technical writing abilities for seminars and conferences.							
Outcomes: After learning the course the students should be able to: 1. Identify and define a problem statement in the area of metro construction. 2. Evaluate literature in the area of research and establish scope of work. 3. Develop innovative methodology and prepare a report in constructions of mass transport system							
Detailed Syllabus:							
Guidelines: 1. Individual students need to study recent topics in the field of Metro transportation under the guidance of allocated guide. 2. Students can choose topic related to Metro Development-Construction of Metro, considering recent trends and its societal importance. 3. The extensive Literature Survey, Mathematical Modeling of particular method, experimentation and valuable conclusion is expected from seminar study. 4. Seminar Report should be submitted as a compliance of term work. 5. Technical paper publication is expected as the outcome of the seminar. 6. Students needs to complete their seminar in a given time frame							
Standard Codes: 1. The Metro Railway Corporation and Maintenance ACT 2002 PART A – Act Indian Railway Board Act, 1905 2. The Railways Act, 1989 Railway Protection Force Act, 1957 PART B – Codes 3. Indian Railways Administration and Finance an Introduction Indian Railways Code for the Accounts Department Part - I 4. Indian Railways Code for the Accounts Department Part – II 5. Indian Railways Establishment Manual Volume-I 6. Indian Railways Establishment Manual Volume-II 7. Indian Railway Commercial Manual Volume-I							

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VII (Scheme B)		
Course:	Mini Project			Code:	BCI27HN07		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
5	-	10	-	75	50	-	125
Detailed Syllabus:							
Objectives: 1. To plan for various activities of the project and channelize the work. 2. To analyze, design and implement real time applications using available platforms. 3. To prepare a feasibility study for a metro project							
Outcomes: After learning the course the students should be able to: 1. Understand, plan and execute a Mini Project. 2. Design real time application 3. Identify and define a problem statement in the area of metro construction. 4. Evaluate literature in the area of research and establish scope of work. 5. Develop innovative methodology and prepare a report in constructions of mass transport system 6. Prepare a technical report and presentation based on the Mini project							
Guidelines: 1. Individual students need to design and demonstrate project work under the guidance of an allocated guide. 2. Students can choose the project considering their future implementation in Major Metro Project 3. Project Report should be submitted as a compliance of term work associated with the honor course. 4. Paper publication associated with project as a research outcome is appreciable. 5. Project work preferably should be completed in the laboratory/field as per the needs of the research. 6. Students can approach to MahaMetro for any project related assistance and support 7. On Field projects will be given priority 8. Projects can be carried out on Metro/Mono/Sub-Urban Rail, RRTS etc... 9. Evaluation will be done on a basis of quantum of work and quality of research carried out							
Standard Codes: 1. The Metro Railway Corporation and Maintenance ACT 2002 PART A – Act Indian Railway Board Act, 1905 2. The Railways Act, 1989 Railway Protection Force Act, 1957 PART B – Codes 3. Indian Railways Administration and Finance an Introduction Indian Railways Code for the Accounts Department Part - I 4. Indian Railways Code for the Accounts Department Part – II 5. Indian Railways Establishment Manual Volume-I 6. Indian Railways Establishment Manual Volume-II 7. Indian Railway Commercial Manual Volume-I 8. Metro Policy 2017							

Course syllabus
Semester-VIII
Honors in
Metro Transportation System

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VIII (Scheme A)		
Course:	Mini Project			Code:	BCI28HN08		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
5	-	10	-	75	50	-	125
Detailed Syllabus:							
Objectives: 1. To plan for various activities of the project and channelize the work. 2. To analyze, design and implement real time applications using available platforms. 3. To prepare a feasibility study for a metro project							
Outcomes: After learning the course the students should be able to: 1. Understand, plan and execute a Mini Project. 2. Design real time application 3. Identify and define a problem statement in the area of metro construction. 4. Evaluate literature in the area of research and establish scope of work. 5. Develop innovative methodology and prepare a report in constructions of mass transport system 6. Prepare a technical report and presentation based on the Mini project							
Guidelines: 1. Individual students need to design and demonstrate project work under the guidance of an allocated guide. 2. Students can choose the project considering their future implementation in Major Metro Project 3. Project Report should be submitted as a compliance of term work associated with the honor course. 4. Paper publication associated with project as a research outcome is appreciable. 5. Project work preferably should be completed in the laboratory/field as per the needs of the research. 6. Students can approach to MahaMetro for any project related assistance and support 7. On Field projects will be given priority 8. Projects can be carried out on Metro/Mono/Sub-Urban Rail, RRTS etc... 9. Evaluation will be done on a basis of quantum of work and quality of research carried out							
Standard Codes: 1. The Metro Railway Corporation and Maintenance ACT 2002 PART A – Act Indian Railway Board Act, 1905 2. The Railways Act, 1989 Railway Protection Force Act, 1957 PART B – Codes 3. Indian Railways Administration and Finance an Introduction Indian Railways Code for the Accounts Department Part - I 4. Indian Railways Code for the Accounts Department Part – II 5. Indian Railways Establishment Manual Volume-I 6. Indian Railways Establishment Manual Volume-II 7. Indian Railway Commercial Manual Volume-I 8. Metro Policy 2017							

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VIII (Scheme B)		
Course:	Metro: Operations and Implementation			Code:	BCI28HN09		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
3	3	-	-	20	20	60	100
Prior-Knowledge: Basics of Transportation Engineering-modes of transportation- importance of railway engineering							
Objectives: 1. To impart knowledge of metro operations and fleet management 2. To evaluate the financial feasibility of a metro project 3. To understand the impacts of metro development on environments and relative aspects 4. To impart the knowledge related to estimation and contracting process for metro project							
Outcomes: After learning the course, the students should be able to: 1. Understand the operations and functions of metros 2. Apply logic to understand the concept for the sustainable development for mass transport development 3. Evaluate the economic and financial feasibility of a metro project 4. Perform the estimation and costing of a metro project 5. Understand various methods and techniques available for the repairs and maintenance							
Detailed Syllabus:							
Unit	Description						Duration (H)
1 .	Metro Operations, Fleet Management and passenger information system Operations of Metro Passenger information and ticketing system Fleet management as per the travel demand Design of interchange locations Public-para, para-public transport corridor development						9
2	Environmental Impact assessment of metro Sustainability issues in Urban areas Central pollution control board and state pollution control board guidelines Urban and non-urban traffic noise sources, Noise level factors, Effects of traffic noise, Measurement and prediction, Control measures, Noise studies, Noise standards, Road transport related air pollution, Sources of air pollution, Effects of weather conditions, Vehicular emission parameters, Pollution standards, Measurement and analysis of vehicular emission, Mitigative measures. EIA requirements of highway projects, Procedures, MOEF/World Bank/IRC/UK Guidelines, EIA practices in India.						9
3 .	Economical and financial evaluation of a metro project Economic and Financial analysis of a metro project- case studies of mumbai, pune metro rails systems Types of Appraisals such as Political, Social, Environmental, Techno-Legal, Financial and Economical, Criteria for Project Selection - Benefit - Cost Analysis, NPV, IRR, Pay-Back Period, Break Even Analysis [Fundamental and Application Component], Study of Project Feasibility report and Detailed Project Report (DPR), Role of Project Management Consultants						9
4 .	Estimation, Tendering and Contracting in Metro systems Tender procedure for Metro project Definition of estimation and valuation. Significance (application) of the Course. Purpose of estimation. Type of estimates, data required for estimation as a prerequisite. Meaning of an item of work, and enlisting the items of work for different Civil Engineering projects. Units of measurement. Mode of measurement of building items/ works. Introduction to components of estimates: face sheet, abstract sheet (BOQ), measurement sheet, Rate Analysis, lead statement. Provisional sum & prime cost items, contingencies, work charged establishment, centage charges. Introduction to D. S. R						9

5.	Repairs, Rehabilitation and Maintenance Repairing techniques for the metros, Regular-periodic and special maintenance measures Advancement in the area of repairs and maintenance, Reasons of failures of metro structures, Case studies based on various metro failures	9
	Total	45
Self-Learning: Case study on Pune Metro Economical and financial evaluation.		
Text Books: 1. Kadiyali L.R. Traffic Engineering & Transport Planning. Khanna Publications, 2013. 2. Khisty C.J. and Lall B.K. Transportation Engineering—An Introduction. 3rd Edition, Pearson, 2017. 3. Estimating and Costing in Civil Engineering: Theory and Practice: B.N Dutta - S. Dutta & Company, Lucknow. (2016) 4. Estimating and Costing: R. C. Rangwala, 18th Edition, Charotar Publ. House, Anand (2023) 5. Taylor MAP and Young W, "Traffic Analysis – New Technology and New Solutions", Hargreen Publishing Company, 1998		
Reference Books: 1. Canter L. Environmental Impact Assessment, McGraw Hill. (2012) 2. Kiely G. Environmental Engineering, Tata McGraw Hill. (2007) 3. Rau G.J. and Wooten C.D. Environmental Impact Analysis Handbook, McGraw Hill (1980) 4. Dhameja S.K. Environmental Engineering and Management, S. K. Kataria & Sons. MoEF Guidelines and amendments as updated on http://moef.gov.in 5. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia 6. V. Mote, S. Paul, G. Gupta (2004), Managerial Economics, Tata McGraw Hill 7. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers		
Standard Code: 1. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration 2. Typical PWD Rate Analysis documents		

Program:	B. Tech. (Civil Engineering) - Honors in Metro Transportation System			Semester:	VIII (Scheme B)		
Course:	Seminar			Code:	BCI28HN10		
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	30	20	-	50
Objectives: 1. To work on a specific technical topic in metro transportation systems, in order to acquire the skills for technical communication. 2. To acquire technical writing abilities for seminars and conferences.							
Outcomes: After learning the course the students should be able to: 1. Identify and define a problem statement in the area of metro construction. 2. Evaluate literature in the area of research and establish scope of work. 3. Develop innovative methodology and prepare a report in constructions of mass transport system							
Detailed Syllabus:							
Guidelines: 1. Individual students need to study recent topics in the field of Metro transportation under the guidance of allocated guide. 2. Students can choose topic related to Metro Development-Construction of Metro, considering recent trends and its societal importance. 3. The extensive Literature Survey, Mathematical Modeling of particular method, experimentation and valuable conclusion is expected from seminar study. 4. Seminar Report should be submitted as a compliance of term work. 5. Technical paper publication is expected as the outcome of the seminar. 6. Students needs to complete their seminar in a given time frame							
Standard Codes: 1. The Metro Railway Corporation and Maintenance ACT 2002 PART A – Act Indian Railway Board Act, 1905 2. The Railways Act, 1989 Railway Protection Force Act, 1957 PART B – Codes 3. Indian Railways Administration and Finance an Introduction Indian Railways Code for the Accounts Department Part - I 4. Indian Railways Code for the Accounts Department Part – II 5. Indian Railways Establishment Manual Volume-I 6. Indian Railways Establishment Manual Volume-II 7. Indian Railway Commercial Manual Volume-I							

Vision of the Civil Engineering Department

To establish as a premier civil engineering department in Maharashtra in the coming five years by providing quality education, fostering innovation with ethical values to serve the society.

Mission of the Civil Engineering Department

1. Fostering value-based education to achieve academic excellence with the right attitude and professional ethics.
2. Inculcating a culture of research and innovation, with an aim of serving society in a sustainable manner.
3. Developing skilled civil engineers with an ability to provide solutions to meet national and global challenges in accordance with the needs of the society.

Program Specific Outcomes (PSO) of Civil Engineering Department

1. Graduates in civil Engineering will demonstrate proficiency in practical applications for quality construction work in the domain of Structural Engineering, Water Resources-Environmental Engineering, Geotechnical-Transport and Construction Management.
2. A graduate in Civil Engineering, equipped with the necessary skills and technical knowledge, can become an entrepreneur in the field, capable of identifying business opportunities, developing business plans, managing resources, designing and executing sustainable construction projects for infrastructural development.