M.Tech. Transportation Engineering (Part-Time)

Scheme and Syllabus

Batch 2023 and Onwards

Department of Civil Engineering

Semester 1st									Total Credits=9	
Sr. No.	Category	Subject Code	Course Title	Contact Hours			Maximum Marks		Total Marks	Credits
				L	T	P	Internal	External		
1.	Core Subject	MTTE-101	Advanced Traffic Engineering	3	0	0	40	60	100	3
2.	Core Subject	MTTE-102	Advanced Soil Engineering	3	0	0	40	60	100	3
3.	Department Elective	MTTE-111	Reinforced Soil Design & Construction	3	0	0	40	60	100	3
		MTTE-112	Transportation Economics & Finance)							
		MTTE-113	Transportation & Environment							
4.	Mandatory (Non-Credit)	SBS101C	Introduction to Shaheed Bhagat Singh and his co-patriots	1	0	0	S/US			
Total				**10**	**0**	**0**	**120**	**180**	**300**	**9**

Semester 2nd									Total Credits=8	
Sr. No.	Category	Subject Code	Course Title	Contact Hours			Maximum Marks		Total Marks	Credits
				L	T	P	Internal	External		
1	Core Subject	MTTE-201	Highway Construction Material and Methods	3	0	0	40	60	100	3
2	Core Subject	MTTE-202	Application of GIS in Transportation Engineering	3	0	0	40	60	100	3
3	Core Subject	MTTE-203	Pavement Materials Testing Laboratory	0	0	2	30	20	100	2
Total				**6**	**0**	**2**	**110**	**140**	**300**	**8**

SEMESTER 1st

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Core Subject	MTTE-101	Advanced Traffic Engineering	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. know the traffic flow characteristics
2. study various traffic surveys
3. understand the traffic signal timing design and traffic flow theories.

UNIT-I

Introduction to Traffic Engineering: Properties of traffic engineering elements, road vehicle performance.
Traffic Studies: Volume studies, speed studies, origin & destination studies and parking studies.

UNIT-II

Traffic Control devices: Various traffic control devices, principles of intersection design, design of signalized and unsignalized intersections, signal coordination, traffic regulations and statistical methods.

UNIT-III

Traffic Safety and Level-of-service: Accidents, lighting, capacity and level-of-service analysis**.**
Uninterrupted traffic Flow Theory: Fundamentals of traffic flow theory, uninterrupted traffic flow including macroscopic and microscopic traffic flow models.

UNIT-IV

Interrupted traffic Flow Theory: Fundamentals of interrupted traffic flow, shockwave analysis, car following theory, queuing theory, vehicle arrival: gap and gap acceptance, simulation of traffic systems

Course Outcomes: Upon completion of this course the student shall be able to:

1. use the traffic survey analysis for management of traffic and for designing new road infrastructure
2. design various types of intersections
3. implement of traffic control devices and traffic regulations
4. apply of traffic flow theories in solving congestion problems and use of simulation techniques.

Books Recommended :

1. Kadiyali, L. R., Traffic Engineering and Transport Planning,. Khanna Publishers
2. O'Flaherty C A, "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA
3. Mannering Fred L., Kilarski Walter P. and Washburn Scott S., Principles of Traffic Engineering and Traffic Analysis, Third Edition, Wiley
4. Chakroborty Partha and Animesh Das, Principles of Transportation Engineering, Prentice hall

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Core Subject	MTTE-102	Advanced Soil Engineering	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. understand the engineering properties and behaviour of soil under different field condition and loading.

UNIT-I

Origin, nature and distribution of soils: Engineering behaviour of soils of India, black cotton soils, alluvial silts and sands, laterites, collapsible and sensitive soils, aeolin deposits.

Clay Mineralogy and Soil Structure: Introduction, Gravitational and Surface Forces, Primary valence bonds, Hydrogen bonds, Secondary valence bonds, Basic structural units of clay minerals, Isomorphous substitution, Kaolinite minerals, Montmorillinte mineral, Illite mineral, Electrical charges on clay minerals, Base exchange capacity, Diffused double layer, Adsorbed water, Soil structures.

UNIT-II

Methods of site investigations: Direct methods, Geophysical methods, Seismic methods, Electrical resistivity methods, methods, drilling methods, boring in soils and rocks, Types of soil samples, Types of samplers, Standard Penetration Test.

UNIT-III

Soil Stabilization: Introduction, Mechanical stabilization, Cement stabilization, Lime stabilization, Bituminous stabilization, Chemical stabilization, thermal stabilization, electrical stabilization, Stabilization by grouting.

UNIT-IV

Geosynthetics: Types and functions, materials and manufacturing processes, principles of soil reinforcement, design and construction of geosynthetic reinforced soil retaining structures.

Geosynthetics in pavements: Geosynthetics in roads and railways, separations, drainage and filtering in road pavements and railway tracks.

Course Outcomes: Upon completion of this course the student shall be able to:

1. ascertain the behavior of soil as a construction material or supporting medium for Civil Engineering structures.
2. learn different methods of soil investigation.
3. apply different soil stabilization techniques to the field problems.

Books Recommended :

1. Soil Mechanics in Engineering Practice, Terzaghi and Peck, John Wiley and Sons.
2. Physical and geotechnical properties of soils, Bowles
3. Design aids in soil mechanics and foundation engineering, Kaniraj S.K.
4. Soil Mechanics, Lambe and Whitman, Wiley India
5. Reinforced soil and its engineering application, Swami Saran, I K International

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Departmental Elective	MTTE-111	Reinforced Soil Design & Construction	L	T	P	3
				3	0	0	
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. develop a basic understanding of characteristics of the different types of reinforcing material
2. examine, evaluate and select appropriate reinforcement material as per desired requirements
3. carry out the design of the structures using reinforced soil
4. get acquainted with the geosynthetics, its properties, application and usage in soil stabilization.

UNIT-I

Introduction: Basic concept of the reinforced soil, mechanism design principles, materials used for construction, advantages of reinforced soil.

Practical Applications: Reinforced soil in flyovers bridges and other civil engineering structures, basic components and strength characteristics of reinforced soil, reinforced soil construction detailing.

UNIT-II

Geosynthetics: An overview of geosynthetics, description of geotextiles, geogrids, geonets, geomembranes, geocomposites, geocells- properties and test methods, functions, design methods for separation, stabilization, filtration, drainage.

Retaining Walls: Types of walls, earth pressures for gravity/counter fort walls, structural design of wall and its foundation, stability of the wall-soil system, slip circle analysis.

UNIT-III

Reinforced soil walls: Stability analysis and construction aspects of reinforced soil walls, effect of reinforced sloped backfill on soil wall design, drainage design procedure.

Wall with reinforced backfill: Theoretical analysis, pressure-intensity on the wall, stability against sliding and overturning, design procedure, limitations of the analysis.

UNIT-IV

Foundations on reinforced soil: Brief overview, analysis of strip footing, isolated- square and rectangular footing on reinforced soil bed, determination of pressure ratio.

Soil nailing and anchors: Applications of soil nailing, its components, advantages and limitations, design aspects.

Course Outcomes: Upon completion of this course the student shall be able to:

1. learn the concepts of reinforced soil and its applications in the Civil Engineering field.
2. distinguish between different types and varied applications of geosynthetics.
3. design the reinforced soil walls.

Books Recommended :

1. Designing with Geosynthetics, Robert M. Koerner, Prentice Hall. (2012)
2. Engineering with Geosynthetics, G.V Rao & GVS Suryanarayana Raju, Tata Mc Graw Hill Publishing Co. New Delhi. (1990)
3. Reinforced Soil and its Engineering Application," Swami Saran, New Age Publication. (2006)

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Departmental Elective	MTTE-112	Transportation Economics & Finance	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. gain an insight into road user cost, transportation cost, finance, taxation and economic evaluation of transportation projects
2. acknowledge the economic functions of transportation systems
3. analyze and evaluate the operating costs of vehicles
4. get acquainted with the concept of financing of highway projects and estimation of direct and indirect costs related to transportation.

UNIT-I

Introductory Concepts in Transportation Decision Making: Overall transportation project development, budgeting, financial planning, the process of transportation project development, models associated with transportation impact evaluation

Economic evaluation of transport projects: Need for economic evaluation, cost and benefits of transport projects, time horizon in economic assessment, basic principles of economic evaluation, interest rate, method of economic evaluation, benefit cost ratio method, first year rate of return, net present value method, internal rate of return method, comparison of methods of economic evaluation.

UNIT-II

Vehicle operating costs: Introduction, road user and cost study in India, components of VOC, factors affecting VOC, fuel consumption relationship, spare parts consumption, maintenance and repairs, labour, cost, tyre life, lubricants, utilization, and fixed costs.

Economic analysis of projects: Methods of evaluation - cost-benefit ratio, first year rate of return, net present value, and internal-rate of return methods; indirect costs and benefits of transport projects.

UNIT-III

Value of travel time savings: Introduction, classes of transport users enjoying travel time savings, methodology for monetary evaluation of passengers' travel time, review of work in India on passengers' travel time.

Accident costs: Introduction, relevance of accident costing for a developing country, review of alternative methodologies for accident costing, Indian studies.

UNIT-IV

Traffic congestion, traffic restraints and road pricing: Congestion as a factor in road traffic, traffic restraint, road pricing.

Appraisal and Evaluation of Transportation Projects: Feasibility and evaluation, cost, impacts and performance levels, evaluation of alternatives, analysis techniques, cost-benefit analysis, social and financial benefits, valuation of time, measures of land value and consumer benefits from transportation projects, prioritization of projects, multi-criteria decision assessment.

Highway finance: Methods for raising funds for maintenance, improvement and expansion of transportation networks, taxation and user fee, financing through loans, bonds, PPPs.

Course Outcomes: Upon completion of this course the student shall be able to:

1. analyse transportation project case studies
2. evaluate transportation project case studies.
3. perform analysis to determine vehicle operational cost, losses and expenditure cost of accidents.
4. compare various methods for raising funds for a highway project and chose the most feasible and viable among them.

Books Recommended :

1. Principles of Transportation engineering by Chakroborty& Das, Prentice Hall, India..
2. Highway Engg by S.K Khanna & CEG Justo, Nem Chand Bros., Roorkee
3. Principles and practices of Highway engg by L.R Kadyali, Khanna Publishers, Delhi. Edition 6
4. Principles of Transportation and Highway engg by G.V Rao, Tata Mc grawHill Publishing Co.Ltd. N.Delhi
5. HarralClell G., A Manual for the Economic Appraisal of Transport Projects, World Bank Report, Washington D.C

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Departmental Elective	MTTE-113	Transportation & Environment	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

1. study the relation between transportation and environment and the effect of increasing transportation demand on land use
2. analyze and evaluate the direct and indirect effects of transportation sector on environment
3. get acquainted with various policies of Governmental organizations .

UNIT-I

Environmental effects of transport: Problems of identification, environmental impact assessment, evaluation of environmental impact due to construction of new facilities and the effect of traffic thereon due to bypasses, widening/four laning, expressway; grade separators, assessment and attenuation.

UNIT-II

Assessment of Environmental impacts of Transportation: Noise, vibration, air pollution, emission levels, air-pollution dispersion, the box model, noise generation, noise measurement, noise propagation and mitigation strategies, noise measures, mathematical models of transportation noise, energy consumption and related issues, environmental traffic management, co-ordinated signal system on urban arterial road intersections to reduce air pollution.

UNIT-III

Pedestrian delay and danger: Severance, accidents, visual intrusion and aesthetics, toxic freight, construction effects.

UNIT-IV

Land consumption and land-use effects: Planning blight and compensation; global climate, energy and resource use; and sustainability, GOI policies and requirements for clearances for road projects. emergency care, institutions and management of traffic safety, education, training, policing, penalties, risk perception, probability, indices and indicators.

Course Outcomes: Upon completion of this course the student shall be able to:

1. learn about measures for controlling pollution for various transportation systems
2. aware of various environmental regulations
3. carry out EIA of an existing transportation facility and suggest required modifications to minimize the overall impact.

Books Recommended :

1. The Art of Regression Modeling in Road Safety,Hauer, E, Springer, 2015
2. The Way Forward: Transportation Planning and Road Safety. Tiwari, G., Mohan, D. and Muhlrad, N.(eds) New Delhi: Macmillan India Ltd., 2005.
3. Transport, Climate Change and the City, Robin Hickman and David Banister. Routledge, London, 2014
4. Human Factors in Traffic Safety, Paul Olson and Robert Dewar (2007) Amazon Digital.
5. World Report on Road Traffic Injury Prevention, Peden, M., et al. World Health Organization, Geneva, 2004.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Mandatory (Non-Credit)	SBS101C	Introduction to Shaheed Bhagat Singh and his co- patriots	1	0	0	S/US

1. Introduction to Bhagat Singh as a person through the eyes of his colleagues.
   Family background and childhood, Education and participation in National Freedom Movement, his visits to Jallianwala Bagh and Nankana Sahib.

2. His contribution to National Freedom Moment.
   Building of Youth Movement , His contribution through his writings, National College Movement and his comrades, Dwarka Das Library and Lahore Science movement, List of books Shaheed Bhagat Singh read.

3. Shaheed Bhagat Singh's experiences at Kanpur
   As journalist and joining Hindustan Republican Association.

4. His return to Punjab
   Jatto Morcha, His First experience of underground life, Shaheed Bhagat Singh at Kisri Magazine, Establishment Hindustan Socialist Republican Association

5. Shaheed Bhagat Singh's attacks on British rule
   Saunders case, Assembly bomb case, Hunger Strike for Jail Reforms, Cut Short Justice system of the British.

6. Overall contributions and his vision of free India.

Books Recommended :

1. Sardar Bhagat Singh by Jatinder Nath Sanyal, National Book Trust New Delhi

SEMESTER 2nd

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Core Subject	MTTE-201	Highway Construction Material and Methods	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

4. To get acquainted with quality assurance, and economic selection of pavement materials.
5. To be able to perform all the necessary lab tests required to be done on highway construction materials.
6. To familiarize the fundamentals of mix design and carry out mix design.
7. To study and evaluate the applications of the recent trends in the field of highway construction materials.

UNIT-I

Sub-grade Soil Characterization: Properties of sub-grade layers; different types of soils, Mechanical response of soil; Soil Classification; Index and other basic properties of soil.

Introduction to Soil Stabilization: Physical and Chemical modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen. Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control.

UNIT-II

Aggregate Characterization: Desirable characteristics of Road aggregates, proportioning of aggregates, Artificial aggregates, Sustainability and availability of sound aggregates.

Bitumen and Bituminous Concrete Mix Characterization: Bitumen sources and manufacturing, Chemistry of bitumen, bitumen structure, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, Resilient, Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes.

UNIT-III

Modified bitumen and Design of Bituminous mix: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Introduction to emulsified bitumen and its characterization; Long term and short-term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFOT and PAV. Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall's specifications, Bituminous Road construction Procedure

UNIT-IV

Cement Concrete Pavement: Types of cements and basic cement properties, Special cements; Quality tests on cement; Tests on cement concrete including compressive strength, flexural strength, modulus of elasticity and fatigue properties; Introduction to advanced concretes like self-compacted concrete, Light weight concrete, Roller Compacted Concrete for pavement application; IS method of cement concrete mix design with case studies; Role of different admixtures in cement concrete performance; Joint filers for Jointed Plain Cement Concrete Pavements and their characterization; Nano technology applications in cement concrete, Concrete road construction.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Examine the properties of the highway materials and perform Bituminous Mix Design.
2. Determine the suitability of the concrete and bituminous mixes in compliance to codal provisions.
3. Reduce cost with minimum adverse impact on environment.

Books Recommended :

1. Principles of Transportation engineering by Chakroborty& Das, Prentice Hall, India
2. Highway Engg by S.K Khanna& CEG Justo, Nem Chand Bros., Roorkee
3. Principles and practices of Highway engg by L.R Kadyali, Khanna Publishers, Delhi. Edition 6.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
				L	T	P	
1.	Core Subject	MTTE-202	Application of GIS in Transportation Engineering	3	0	0	3
Internal Marks: 40, External Marks: 60, Total Marks: 100							

Course Objectives: The course should enable the students to:

2. Expose the students to the concept of digital mapping, to make them aware of recent advancements/software in surveying like Remote sensing, digital photogrammetry, GIS, DIP etc.
3. To familiarize with map projections and working with co-ordinate systems
4. To get acquainted with data analysis of vector based and raster based data

UNIT-I

Modern Trends in Surveying and Mapping: Digital Mapping, Uses and applications, data collection techniques (Conventional and Nonconventional), Present Status in India and abroad.

Aerial Photogrammetry: Introduction, types, Stereoscopy, Scale of a photograph, flight planning, Mosaics, Crab & Drift, Overlap & Side lap.

UNIT-II

Geographical Information System (GIS): Introduction, advantages, objectives of GIS, Definitions of GIS, Components of GIS, Overlay analysis, Digital Terrain Modelling, Digital Elevation Model Applications of GIS in transportation engineering fields, Four M's, Elements of Image visualization

UNIT-III

Introduction to Remote Sensing (RS): Introduction, EM spectrum, Ideal RS System, Real RS System, Visual Image interpretation, active and passive remote sensing, Reflectance; spectral reflectance of land covers; Spectral characteristics of solar radiation; energy interaction in atmosphere; energy interactions with Earth's surface, Spectral reflectance curves, Resolution

UNIT-IV

Digital Image Processing (DIP): Introduction, Histogram and image statistics, Remote Sensing Image distortion and rectification: Radiometric errors and Geometric errors. Image Enhancement Techniques, Image classification – Supervised and Unsupervised classification, Formats

Global Positioning System: Introduction, GPS, DGPS, Applications,Software demonstrations and working GIS/RS software.

Course Outcomes: Upon completion of this course the student shall be able to:

4. Apply the concepts and analytical methods related to surveying
5. Use the various surveying equipment
6. Plan and execute surveying projects
7. Prepare a map and concepts of 3-D view
8. Identify the potential use of Remote Sensing and GIS in Civil Engineering

Books Recommended :

6. Geomatics Engineering, Manoj Arora and R C Barjatiya, Nem Chand Brothers, Roorkee.
7. Principles of GIS, Peter A. Burrough, Rachael A., Oxford University Press
8. Remote Sensing and Image Interpretation, Lillesand and Kiefer, Wiley Publishers
9. Surveying Vol. I & II, B.C. Punmia, A.K. Jain & Jain. Luxmi Publications (P) Ltd., New Delhi.
10. Principle Practices & Design of Highways Engg., S. K. Sharma. S. Chand Publishing , New Delhi.

Sr. No.	Category	Subject Code	Course Title	Contact Hours			Credits
1.	Core Subject	MTTE-203	Pavement Materials Testing Laboratory	L	T	P	2
				0	0	2	
Internal Marks: 30, External Marks: 20, Total Marks: 50							

Course Objectives: The course should enable the students to:

5. Have knowledge about the various tests which need to be carried out on soils, aggregate and bitumen for the design of bituminous mixes and pavements. Evaluation tests for pavement strengthening and use of software in highway development

List of Experiments:

1. Tests on Soils (Gradation, atterberg limits, OMC and CBR).
2. Test on Aggregates (Aggregate grading and Proportioning, Impact, Abrasion crushing, water absorption, specific gravity).
3. Tests on Bitumen and Bitumen Mixes (Marshall method of mix design and Bitumen content test).
4. Pavement Evaluation tests (Benkelman beam test).
5. To determine modulus of subgrade reaction (K-value) of rigid pavement.
6. Exposure to latest software.

Course Outcomes: Upon completion of this course the student shall be able to:

1. Knowledge about tests and bituminous mix design which will give the students added confidence when they go actually in the field.

Books/Codes Recommended :

1. Khanna, S. K., Justo, C. E. G., and Veeraragavan, A., Highway Materials laboratory Testing, Nem Chand & Brothers.
2. Relevant IRC and AASHTO Codes.