Shri Jagdishprasad Jhabarmal Tibrewala University

(Civil Engineering Department)

Detailed Syllabus of M.Tech.

(Transportation Engineering)

SHRI JAGDISHPRASAD JHABARMAL TIBREWALA UNIVERSITY
श्री जगदीशप्रसाद झाबरमल टीबडेवाला विश्वविद्यालय

INSTITUTE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Teaching & Scheme of Examination for M.Tech (Transportation Engineering)

EFFECTIVE FROM ACADEMICSESSION 2019-2021

Year: I **Semester: I**

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Theory									
1	MTE-101	Statistical Methods in Transportation Engineering	3	1	-	3	30/12	70/28	100/40
2	MTE-102	Highway Materials	3	1	-	3	30/12	70/28	100/40
3	MTE-103	Traffic Engineering	3	1	-	3	30/12	70/28	100/40
4	MTE-104	Elective-I	3	1	-	3	30/12	70/28	100/40
Practical's									
5	MTE-105	Highway Material Testing Laboratory	-	-	3	3	40/16	60/24	100/40
		Total	**12**	**4**	**3**				**500**
		Total Teaching Load	**19**						

DETAILED SYLLABI FOR M. TECH. FULL TIME

TRANSPORTATION ENGINEERING

MTE-101: Statistical Methods in Transportation Engineering.

1. **Probability distributions**: Introduction to probability and random variables, Binomial distribution, Poisson distribution, Geometric distribution, Hyper Geometric distribution, Normal distribution, Log-Normal distribution, Uniform distribution, Exponential distribution, Gamma distribution, Beta distribution, and Weibull distribution.
2. **Parameter Estimation and hypothesis Testing**: Random samples, sampling distributions of mean and variance. Point estimators, the method of maximum likelihood, and the method of moments. Confidence interval . Statistical hypothesis tests, Operations characteristic curve. Tests of hypothesis on the mean of a Normal Distribution, Tests of hypothesis on the means of two Normal distributions, The paired t-test, Tests of hypothesis on one variance, Tests of hypothesis for the equality of two variances, The testing of goodness of fit.
3. **Design and Analysis of Experiments**: Fundamental assumptions of analysis of variance, single factor experiments, Latin square and Greeco-Latin square designs, Design of experiments with several factors- Two factor factorial experiments.
4. **Regression and Correlation Analysis**: Introduction, Bi-Variate Normal distribution and the associated marginal and conditional distributions, estimation and analysis of simple regression models, correlation coefficients, analysis of correlation coefficients, Hypothesis tests associated with regression and correlation coefficients, curvilinear regression models, Multiple regression models, multiple and partial correlation coefficients.

Applications should be taken from transportation planning and traffic engineering.

References:

1. Hines, W. W. and Montgomery, D. C., et. al.; "Probability and Statistics in Engineering and Management Science", John Wiley and Sons, New York, (1990).
2. Freund, J. E.; "Mathematical Statistics", PHI, New Delhi, (1998)
3. Montgomery, D. C.; "Design and Analysis of Experiments", 5th edition, John Wiley and Sons, INC., New York. (2007).
4. Johnston, J. and Dinardo, J.; "Econometric Methods", 4th edition, McGraw-Hill International Editions, (1997).
5. Benjamin, J. R. and Cornell, C. A.; "Probability Statistics and Decision for Civil Engineers", McGraw-Hill, (1960).

MTE-102: Highway Materials

1. **Aggregates:** Classification, physical and strength characteristics, Proportioning of aggregates, Aggregate texture and skid resistance, polishing of aggregates.
2. **Soil:** Classification, Structural and Constructional problems in soil subgrade, Identification and strength tests, Soil-moisture movement, Sub-soil drainage, Soil stabilization, Characteristics and use of Fly Ash, Bottom ash and Pond Ash.
3. **Bitumen:** Bitumen sources and manufacturing, Bitumen constituents, structure and Rheology, Mechanical and engineering properties of bitumen, Tests on bitumen, Emulsions, Tar – Properties, types, modifications, Durability of bitumen, Adhesion of bitumen, Modified bitumen.
4. **Bituminous Mixes:** Desirable properties of mixes, Design of bituminous mixes, Tests on bituminous mixes, Fillers, Theory of fillers and specifications. Marshall, Hubbard Field & Hveam Methods.
5. **Cement Concrete:** Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes for DLC and PQC with appropriate admixtures like flyash and high range water reducing admixtures etc.

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	Krebs, Robert D. And Walker, R. D., "*Highway Materials*", McGraw Hill Book Co., New York	1971
2	Her Majesty's Stationery Office, "*Soil Mechanics for Road Engineers*", Ministry of Transport, Road Research Laboratory, UK	1966
3	Her Majesty's Stationery Office, "*Bituminous Materials in Road Construction*", Ministry of Transport, Road Research Laboratory, UK	1966
4	Her Majesty's Stationery Office, "*Concrete Roads Design and Construction*", Ministry of Transport, Road Research Laboratory, UK	1966
5	Read, J. And Whiteoak, D., "*The Shell Bitumen Handbook*", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London	2003
6	Relevant IRC and IS codes	

MTE-103: Traffic Engineering

1. **Scope of Traffic Engineering & Study of its elements**: Introduction, Objectives and Scope of Traffic Engineering; Components of Road Traffic – Vehicle, Driver and Road; Road User and Vehicle Characteristics and their effect on Road Traffic; Traffic Manoeuvers. Traffic Stream Characteristics- Relationship between Speed, Flow and Density
2. **Traffic Engineering Studies and Analysis**: Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, Methods of Study, Equipment, Data Collection, Analysis and Interpretation (including Case Studies) of (a) Speed (b) Speed and Delay (c) Volume (d) Origin and Destination (e) Parking (f) Accidents.
3. **Design of Traffic Engineering Facilities**: Control of Traffic Movements through Time Sharing and Space Sharing Concepts; Design of Channelising Islands, T, Y, Skewed, Staggered, Roundabout, Mini-roundabout and other forms of AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections, their Warrants and Design Features; Bus Stop Location and Bus Bay Design, Design of Road Lighting
4. **Traffic Control Devices:** Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal Design, Redesign of Existing Signals including Case Studies; Signal System and Coordination.

Suggested Books:

1. Pignataro, L., Traffic Engineering – Theory & Practice, John Wiley, 1973.
2. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2007.
3. The Institute of Transportation Engineers, Transportation and Traffic Engg. Hand Book, Prentice Hall (1982) Chapters 8, 17, 21, 23 and 24.
4. O'Flaherty C A, Highways- Traffic Planning & Engineering, Edward Arnold, UK, 2002
5. McShane W R & Roess R P, Traffic Engineering, Prentice-Hall, NJ, 2010
6. IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas
7. Salter, R J., Highway Traffic Analysis and Design, ELBS, 1996.
8. Matson, Smith and Hurd, Traffic Engineering, Mc-Graw Hill Book Co, 1955.

LIST OF ELECTIVES

MTE-104: ELECTIVE – I

MTE-104.1: Modeling and Simulation in

Transportation

MTE-104.2: Ground Improvement Techniques

MTE-104.3: Finite Element Method

MTE-104.1: Modeling and Simulation in Transportation

1. **Introduction:** Transportation simulation & modeling, decision making, issues in transport modeling, structure of transport models
2. **Multivariate Data Analysis Techniques:** Types of Data, Basic Vectors and Matrices, Sample Estimate of Centroid, Standard Deviation, Dispersion, Variance and Covariance, Correlation Matrices, Principal Component, Factor Analysis, Manova and Cross Classification Procedure in Multivariate Data Analysis and Application to Problems in Traffic and Transportation Planning, Best fit analysis, Distribution analysis.
3. **Simulation:** Elements and attributes, Random number generation, Pseudo random number generation, Cycle repeatability, Feedback & evaluation, Evaluation of system performance, Marginal & corridor simulation, Gaming simulation.
4. **Data and Spacing:** Sampling theory, Errors in modeling and forecasting, Data collection methods, Network and zoning system
5. **Discrete Choice Models:** Theoretical framework, specification and functional form of models, statistical estimation and validation of models, binary choice, multinomial and nested logit models, modeling with stated preference data, model aggregation, updating and transferability.
6. **Simplified Transport Models:** Sketch planning method, Model estimation from traffic count.
7. **Time Series Analysis:** Basic Components of Time Series – Stationary and Non-Stationary Process – Smoothing and Decomposition Methods – Correlation and Line Spectral Diagrams – Auto Correlations and Moving Averages.

Study of large scale simulation models such as VIT, Transyt, Sigop etc.

Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Ortuzar de D.O. & Willumsen, L.G., "Modelling Transport", John Wiley & Sons.	1993
2	Banks, J., Carson, J.S. and Nelson, B.L., "Discrete Event System Simulation", Prentice-Hall of India.	1998
3	Ben-Akiva, Moshe and Lerman, S. R., 'Discrete Choice Analysis: Theory and Application to Travel demand', MIT Pressserie3s in Transportation Studies, USA	1985
4	Hutchinson, B.G. "Principles of Urban Transport Systems Planning", SCRIPTA Book Company.	1974
5	Joseph F. Hair, Jr., William C. Black, Barry J. Babin and Rolph E. Anderson, 'Multivariate Data Analysis', Prentice Hall.	2010

MTE-104.2: Ground Improvement Techniques

1. **Introduction**: Typical situations where ground improvement becomes necessary, Historical review of methods adopted in practice, Current status and the scope in the Indian context
2. **Methods of Ground Improvement**: Mechanical compaction, Dynamic compaction, Impact loading, Compaction by blasting, Vibro-compaction; Pre-compression, Dynamic consolidation, Design aspects of stone columns; Use of admixtures, Injection of grouts; Design guidelines and quality control, Design examples on preloading with sand drains, Road designs with Geo-synthetics
3. **Reinforced Earth**: Basic mechanism, Constituent materials and their selection; Engineering applications – Shallow foundations on reinforced earth, Design of reinforced earth retaining walls, Reinforced earth embankments structures, Wall with reinforced backfill, Analysis and design of shallow foundations on reinforced earth
4. **Geo-textiles**: Selection and engineering applications, Design examples, Stabilisation/Improvement of ground using Geo-membranes, Geo-cells, Geonets, Geo-synthetic walls.
5. **Soil Nailing** : Construction of underground structures, Landslide controls, Deep vertical cuts, contiguous piles
6. **Problematic Soils**: Use of ply soils, Improvement of saline soils, Improvement of black cotton soils, Collapsible soil, Dune Sand.

Suggested Books :

1. Moseley, M. P. and Kirsch K., "Ground Improvement", Spon Press, Taylor and Francis 2004
2. Mittal, Satyendra, "Ground Improvement Engineering", Vikas Publishing House 2010
3. Koerner, R.M., "Designing with Geosynthetics"' Prentice Hall 1990
4. Saran, S., "Reinforced Soil and Its Engineering Applications", I.K. International 2005
5. Rao, G.V., Geosynthetics – An Introduction, Sai Master Geoenvironmental Services (P) Ltd. 2007
6. Jones, CJFP, "Earth Reinforcement and soil structure", Thomas Telford 1996
7. Shukla, S.K., Yin, Jian-Hua, "Fundamentals of Geosynthetic Engineering", Taylor & Francis

MTE-104.3: Finite Element Methods

1. **Basic concepts, discretization :** Displacement, force and hybrid models, interpolation functions for general element formulations, compatibility and completeness
2. **Polynomial forms :** One dimensional elements, geometric isotropy, triangular elements, rectangular elements, three dimensional elements, isoparametric formulations, axisymmetric elements, numerical integration
3. **Applications in solid mechanics :** Plane stress/strain, FE formulation, CST, LST, stiffness matrix, load matrix formation, rectangular element isoparametric formulation, plate elements and shell elements, three dimensional elements; FE formulation : axisymmetric stress analysis, torsion, interface elements, infinite elements
4. **Application in structural dynamics and vibrations:** Mass (consistent and diagonal) and damping matrices, modal analysis, time history analysis, explicit direct integration/implicit direct integration and mixed methods
5. **Introduction to non-linear problems:** Geometric and material (elasto-plastic), solution methods: Newton-Raphson method, modified Newton-Raphson method, arc method, a problem of geometric nonlinearity
6. Stationary principles, Rayleigh Ritz method and interpolation; weighted residual methods and variational methods, numerical errors and convergence

Suggested Books:

1. K. J. Bathe, “Finite Element Procedures”, 4th ed., Prentice-Hall of India Private Limited, New Delhi 2002
2. R.D. Cook, D.S. Malkus, M.E. Plesha,” Concepts and Applications of Finite Element Analysis”, 4th ed., John Wiley & Sons, New York 2007
3. O.C. Zeinkwicz,” The Finite element Method”, 6th ed., Tata McGraw- Hill Publishing Company Limited, New Delhi 2005
4. J.N. Reddy,” An introduction to Finite element Method”, 3rd ed., McGraw- Hill Book Company, New Delhi 2005

MTE-105: Highway Material Testing Laboratory

List of Practical:

Tests for Characterization and use of Highway materials

01. Identification tests on soils ; Heavy compaction test on subgrade soil
02. Triaxial test on pure subgrade soil
03. California Bearing Ratio test
04. Tests on aggregates – Determination of Deleterious substance as per IS code
05. Aggregate polishing and skid resistance test (demonstration); GSB mix design
06. Test for aggregate durability; Preparation of mix for BC/DBC/ SDBC
07. Tests on flyash, pondAsh and bottomash- gradation and other engineering properties required for use as embankment material
08. Tests on Bitumen – Penetration Test and Ductility test
09. Tests on Bitumen – Softening point test and Thin Film Oven test
10. Elastic recovery/recovery test on binder
11. Marshall Bituminous Mix design, Bitumen viscosity test (Rotational viscometer); Retained stability test
12. Benkelman Beam test on road
13. Concrete Mix design – Sample preparations for DLC and PQC with proper ingredients and admixtures for economy.
14. Concrete Mix design – Testing of samples and statistical inferences

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Year: I **Semester: II**

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Theory									
1	MTE-201	Urban Mass Transportation System	3	1	-	3	30/12	70/28	100/40
2	MTE-202	Transportation Planning	3	1	-	3	30/12	70/28	100/40
3	MTE-203	Pavement Analysis, Design and Construction	3	1	-	3	30/12	70/28	100/40
4	MTE-204	Elective-II	3	1	-	3	30/12	70/28	100/40
Practical's									
5	MTE-205	Computer Aided Traffic studies Lab	-	-	3	3	40/16	60/24	100/40
		Total	**12**	**4**	**3**				**500**
		Total Teaching Load	**19**						

MTE-201: Urban Mass Transportation System

1. **Introduction**: Mass transit systems, Elements / components of transit systems; Urban Mass Transit systems- types, characteristics, suitability and adaptability of these systems; Evolution of urban transportation.
2. **Transit System Planning**: Planning needs; Short-range and long-range planning; Planning procedures and methodology, Data collection; Medium performance transit systems and high-performance transit systems; trends in transit planning.
3. **Transit Demand Estimation and Evaluation:** Transit demand forecasting; transit mode evaluation; comparison and selection of most suitable transit mode.
4. **Transit System Operations:** Basic operational elements; transit travel characteristics; transit scheduling; transit line analysis – planning objectives, geometry, types and their characteristics, capacity of transit lines, system procedures for improving transit line capacity.
5. **Transit Networks and System Analysis:** Transit networks – types and their characteristics; transfers in transit networks; system analysis in transit – conceptual models, modeling procedures; terminal or station location planning – issues, objectives, station spacing decisions.
6. **Economics and Financing of Transit Systems:** Transit system performance and economic measures; transit fares – structure, collection and levels; financing of transit services; public and private integration of transit services
7. **Case studies of urban mass transportation systems adopted in India in recent years including Delhi Metro, Jaipur Metro, metro bus service, mono rail etc.**

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	Vukan R. Vuchic, "Urban Transit – Operations, Planning and Economics", John Willey and Sons, Inc., USA	2004
2	John W. Dickey and others, "Metropolitan Transportation Planning", Tata McGraw-Hill Book Company Ltd., New Delhi	1980
3	C A O'Flaherty, 'Transport Planning and Traffic Engineering', Butterworth-Heinemann, Burlington	2006
4	C Jotin Khisty and B Kent Lall, "Transportation Engineering" Prentice-Hall of India Pvt Ltd., New Delhi	2003

MTE-202: Transportation Planning

1. **Introduction to transportation planning:** Fields of transportation Engineering; System-Environment Ensemble; Transportation planning process; Transportation problems and problem solving process.
2. **Transportation data and survey methods:** Type of Transportation data and its sources, Data quantity and quality, Accuracy and Precision, Sampling techniques, sample sizes, Transportation Planning surveys – Documentation searches, Person surveys, Household surveys, In-transit surveys, Road-side surveys, etc.
3. **Transportation Modes and Technologies**: Technologies of Transport and System Components, Network Analysis; Minimum Path Algorithms, Path Characteristics, Path-Vehicle Interaction – Discrete Flows and Continuous Flows, Vehicle and its Performance, System Performance, Vehicle and Container, Weight to Volume relation, Terminal Planning, Operational Planning
4. **Four-stage Sequential Planning:** Urban transportation planning process; trip generation, correlation analysis and regression analysis; trip distribution, Growth factor methods and Synthetic methods; modal split models, first generation, second generation, behavioural models; minimum travel path computations; Trip assignments, route assignment, multiple assignment and network assignment.
5. **Land use–Transportation Planning:** Urban Forms, mobility and activity hierarchy; accessibility-based early-era models; Lowery's model and its derivatives; Modern era models.

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	B. G. Hutchinson, "Principles of Urban Transport Systems Planning" Scripta Book Co., Washington	1974
2	Anthony J. Richardson, Elizabeth S. Ampt and Arnim H. Meyburg, "Survey Methods for Transport Planning" Eucalyptus Press, Australia.	1995
3	Roy Thomas, "Traffic Assignment Techniques", Avebury Technical, Aldershot, England	1991
4	C A O'Flaherty, ed , "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA	2006
5	C Jotin Khisty and B Kent Lall, "Transportation Engineering – An Introduction", Prentice Hall of India Pvt Ltd., New Delhi	2003

MTE-203: Pavement Analysis, Design and Construction

1. **Introduction :** Components of pavement structure, importance of sub-grade soil properties on pavement performance. Functions of sub-grade, sub-base, base course and wearing course.
2. **Stresses in Flexible Pavements:** Stresses in homogeneous masses and layered systems, deflections, shear failures, equivalent wheel and axle loads.
3. **Elements in Design of Flexible Pavements :** Loading characteristics-static, impact and repeated loads, effects of dual wheels and tandem axles, area of contact and tyre pressure, modulus or CBR value of different layers, equivalent single wheel load, equivalent stress and equivalent deflection criterion, equivalent wheel load factors, climatic and environmental factors.
4. **Design Methods for Flexible Pavements:** California bearing ratio (CBR) , U.S. Navy method. Triaxial method, Mcleod method, Boussinesq's and Burmister's analysis and design method, IRC method for Flexible Pavement Design.
5. **Rigid Pavements:** Wheel load stresses, Westergaard's analysis, Bradbury's approach Arlington test, Pickett's corner load theory and charts for liquid, elastic and soil of finite and infinite depths of subgrade. IRC Method of rigid pavement design.
6. **Temperature Stresses:** Westergaard's and Thomlinson's analysis of warping stresses, Combination of stresses due to different causes, Effect of temperature variation on Rigid Pavements.
7. **Reinforced Concrete Slabs:** Prestressed concrete slabs-general details. Design of Tie Bars and Dowel Bars.
8. **Road Construction:** Bituminous road construction procedures and specifications, Quality control requirements. Concrete Road construction: Construction methods, Quality control requirements, Joints in cement concrete pavements, reinforced cement concrete road construction. IRC & MORTH recommendations for construction of Bituminous and Concrete roads. Present practices being followed for quality assurance and speedy construction in the country like by NHAI.
9. **Pavement analysis, design and construction without joints and in integral bridges, case studies of such construction adopted in the country including that in Delhi Metro.**

~~11.~~ Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Yoder, E.J. and Witczak, M.W., "Principles of Pavement Design 2nd Ed", John Wiley & Songs, Inc.	1975
2	O'Flaherty, A. Coleman, "Highways : the Location, Design, Construction and Maintenance of Road Pavements", 4th Ed., Elsevier	2006
3	Fwa, T.F., "The Hand Book of Highway Engineering", CRC Press Taylor & Francies Group.	2006
4	Khanna, S.K. and Justo, C.E.G., "Highway Engineering Nem Chand Jain & Bros,	2005
5	Papagiannakis, A.T. and Masad, E.A., "Pavement Design and Materials, John Wiley & Sons Inc.	2008

MTE-204: ELECTIVE – II

MTE-204.1: Bridges Design

MTE-204.2: GIS Application in Transportation Engineering

MTE-204.3: Transportation-Environment Interaction and Analysis

MTE-204.1: Bridges Design

1. **Introduction** – Classification and components of bridges– layout and planning.–
2. **Structural forms of bridge decks** – Grillage analysis of slab decks, beam and slab decks, cellular decks, orthotropic decks-features, design .
3. **Standard specifications for Bridges** – IRC loadings for road bridges – standards for railway bridges – design of RC slab, skew slab and box culverts. Design of T beam bridges – balanced cantilever bridges – rigid frame bridges – Arch bridges – bow string girder bridges, fly overs.
4. **Design of Steel bridges-** Deck type and through types- both. Design of plate girder Bridges,— Steel trussed bridges including stringer, cross girder and main section analysis and design, , foot over bridges, Design of Bracings – Top and Bottom lateral bracings, Portal and Sway bracings. Relevant standards and design practices for steel bridge design.
5. Introduction to long span bridges: cable stayed bridges and suspension bridges, instability in bridges.
6. **Forces on Piers and Abutments** – Design of piers and abutments – types of wing walls–,– Special provisions for forces on abutments in case of integral bridges, relevant design features, types of bearings – design of bearings for conventional types and modern bridges.

References

1. E.C. Hambly, Bridge deck behaviour, Chapman and Hall, London

2. E.J. O'Brien and D.L. Keogh, Bridge deck analysis, E& FN Spon, New York

3. D.Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi.

4. N.Krishna Raju, Design of bridges, Oxford & IBH publishing Co. Ltd., New Delhi.

5. Jaikrishna and O.P Jain, Plain and reinforced concrete-vol.II, Nem Chnand & Bros,Roorkee.

6. IRC: 5, Standard specifications and code of practice for road bridges, Sections I to V, Indian Roads Congress, New Delhi.

7. Indian railway standard code of practice for the design of steel or wrought iron bridge carrying rail, road or pedestrian traffic, Govt. of India, Ministry of Railways, 2000..

8. IS: 800-2007.

MTE-204.2: GIS Application in Transportation Engineering

1. **Introduction: Definitions of GIS** – Components of GIS – Geographic data presentation: maps – mapping process – coordinate systems – transformations – map projections – geo referencing - data acquisition.
2. **Geographic Data Representation, Storage, Quality and Standards**: Storage - Digital representation of data – Data structures and database management systems – Raster data representation – Vector data representation – Concepts and definitions of data quality – Components of data quality – Assessment of data quality – Managing data errors – Geographic data standards.
3. **GIS Data Processing, Analysis and Modeling**: Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts and nearest neighbour analysis – Network analysis – Surface modeling – DTM.
4. **GIS Applications**: Applications of GIS in Environment monitoring – Natural hazard management, Transport Planning, Analysis and monitoring. Use of softwares related to GIS applications in Transportation Engineering.

Suggested Books:

1. Lo, C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2006.
2. Anji Reddy, M., Remote Sensing and Geographical Information Systems, B.S.Publications, Hyderabad, 2001.
3. Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
4. Clarke, K., Getting Started with Geographic Information Systems, Prentice Hall, New Jersy, 2010.
5. DeMers, M.N., Fundamentals of Geographic Information Systems, John Wiley & Sons, New York, 2002.
6. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992
7. Jeffrey, S. & John E., Geographical Information System – An Introduction, Prentice-Hall, 1990
8. Marble, D.F., Galkhs HW & Pequest, Basic Readings in Geographic Information Systems, Sped System Ltd., New York, 1984.

MTE-204.3: Transportation-Environment Interaction and Analysis

1. **Introduction:** Interaction of transportation systems and facilities with surrounding environment, Imapct of transportation on surrounding environment, impact of surrounding environment on transportation systems.

2. **Impact on Natural Environment:** Air quality impacts - sources of air pollutants, effects of air pollutants, key legislations and regulations, impact prediction approaches, identification and incorporation of mitigation measures; Noise Impacts - Basic information, key legislation and guidelines, impact prediction methods, identification and incorporation of mitigation measures, Noise barriers and their design; Ground water and marine pollution impacts; Environmental capacities of streets, Environmental Impact statements.
3. **Impact on Land Use and Value:** Conceptual approach for addressing socio-economic impacts; Visual impacts and criteria, scoring methodologies for visual impact analysis; Relocation impacts; Land value impacted due to transportation facility; Spatial reorganization and Regional Development impacts

4. **Environmental Impact Analysis:** Concepts of environmental impact analysis, key features of National environmental policy act and its implementation, screening in the EIA process, utility and scope of EIA process, Environmental protection acts EIA at national level, Conceptual approach for environmental impact studies, planning and management of impact studies, matrix and network methodologies for impact identification, description of the affected environmental – environmental indices; Public Participation – Objectives, and techniques for conflict management and dispute resolution, verbal communication in EIA studies .

5. **Energy Issues in Transportation:** Energy consumption, alternate transportation fuels, energy conservation, energy contingency strategies, energy analysis information and methods, Transportation alternatives.

References:

1. CANTER, L.W., Environmental impact assessment, McGraw-Hill, 1997
2. Peter Morris & Riki Therivel, Methods of Environmental Impact Assessment, Routledge, 2001.
3. Denver Tolliver, Highway Impact Assessment, Greenwood Publishing Group, 1993.
4. Edward K Morlok, Introduction to transportation Engineering and Planning, Mc-Graw Hill Book Company, New Delhi
5. John W. Dickey and others, Metropolitan Transportation Planning, Tata McGraw-Hill Publishing Compant Ltd., New Delhi
6. C. Jotin Khisty and B Kent lall, Transportation Engineering – An introduction, Prentice-Hall of India Pvt Ltd, New Delhi.

MTE-205: COMPUTER AIDED TRAFFIC STUIDES LAB

Experiments related to traffic data collections on speed, volume, travel time, delay, etc. Traffic studio (students will learn to use geometric design software and video data analysis software). Demonstrations of various equipments including possible visits to labs in national Institutes like CRRI, IITs and road systems. Study & application software for design of pavement (Rigid & Flexible), traffic flow, traffic capacity modeling, transportation analysis and planning, intersection design, signals, Lab work includes Study of Softwares, their application to Solution of Transportation Engineering problems.

The experiments may include:

1. Traffic volume data collection at midblock section in urban area and its analysis
2. Traffic volume data collection at rural highway section and its analysis
3. Categorized vehicle speed data collection at urban and rural sections and its analysis
4. Deriving flow relationships between flow characteristics based on volume and speed data collected
5. Speed and delay study using Moving observed method
6. Volume study at a roundabout to examine its capacity
7. Volume and speed study at a four legged intersection
8. Parking study in a market or commercial area (accumulation and duration analysis)
9. Analysis of accident data procured from police stations
10. Demonstration and hands-on training with transportation software for design of flexible as well as rigid pavements.
11. Road Safety Audit of a rural section of a highway

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EFFECTIVE FROM ACADEMICSESSION 2019-2021

Year: II **Semester: III**

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Theory									
1	MTE-301	Pavement Maintenance and Management System	3	1	-	3	30/12	70/28	100/40
2	MTE-302	Transportation System Analysis	3	1	-	3	30/12	70/28	100/40
Practical's									
3	MTE-303	Seminar	-	-	3	3	40/16	60/24	100/40
4	MTE-304	Dissertation Stage-I	-	-	3	3	80/32	120/48	200/80
Total			**6**	**2**	**6**				**500**
Total Teaching Load			**14**						

MTE-301: Pavement Maintenance and Management System

1. **Pavement Evaluation and Performance:** General concept of pavement evaluation, evaluation of pavement performance, evaluation of pavement structural capacity, evaluation of pavement distress, evaluation of pavement safety.
2. **Types of Distress:** Structural and functional, serviceability, fatigue cracking, pavement deformation and behaviour in flexible and rigid pavements. Low temperature shrinkage cracking. Factors affecting performance, relation between performance and distress.
3. **Pavement Evaluation & Measuring Equipments:** Functional & Structural Evaluation, Functions Parameters such as Roughness, Distress, Rutting, Skid Resistance etc. Structural Parameters such as Structural Capacity. Benkelman Beam, Bump Integrators of various types, dynaflect. Demonstration of equipments for dynamic testing of pavements. Digital ultrasonic concrete tester. Radiographic and infra red testing. Pavement skid resistance measuring equipments, fatigue testing equipments, on-site and on- line testing with sensors, strain-gages LVDTs and data acquisition system.
4. **Pavement Overlays:** Flexible overlays and determination of overlay thickness. Rigid overlays and determination of overlay thickness including thin toppings. Design of Overlay by Benkelman Beam and Falling Weight Deflectometer.
5. **Design Alternatives – Analysis, Evaluation and Selection:** Framework for pavement design, design objectives and constraints, Basic structural response models, characterization of physical design inputs, Generating alternative pavement design strategies. Economic evaluation of alternative pavement design strategies, analysis of alternative design strategies. Predicting distress, predicting performance, selection of optimal design strategies.
6. **Pavement Management System:** Introduction to Pavement Management System (PMS) & Maintenance Management System (MMS), construction, maintenance and rehabilitation. Feedback data system. Examples of Working Design and Management Systems. Implementation of a pavement management system.

Suggested Books:

S. No.	Name of Books / Authors	Year of Publication
1	Hass, R., Hudson, W.R. and Zaniewski, J. "Modern Pavement Management" Krieger.	1994
2	Fwa, T.F., "The Hand Book of Highway Engineering", CRC Press, Taylor & Francies Group.	2006
3	Shain, M.Y., "Pavement Management for Airports, Roads and Parking Lots", Kluwer Academic Publishers Group.	2004
4	Khanna, S.K. and Justo, C.E.G., "Highway Engineering" Nem Chand & Bros, Roorkee (U.A.) 8th Ed.	2005
5	Hudson, W.R., Haas, R. and Uddin, W., "Infrastructure Management", McGraw Hill.	1997
6	Hass R. & Hudson, W.R., "Pavement Management System", Mc Graw Hill Company, Inc. New York	1978

MTE-302: Transportation Systems Analysis

1. **Introduction**: Scope of transportation and impact on society; System planning process and problem solving process; transportation problems.
2. **Transportation Technologies**: Transportation technologies, suitability and adaptability; Transportation system components; Transportation system characteristics – technological and operational; Technologies for surface, below surface and above surface transportation and their combinations, suitability of such systems in urban and rural areas.
3. **Analysis of Systems:** Generation of alternatives; Performance evaluation of system and performance functions; Operational planning and analysis of components; Travel in space and time; Planning for non-motorized transportation; Freight transportation planning–models and methods; Residential location choice models, Car-ownership models; transportation software.
4. **Transportation Economics:** Transportation demand and supply; Equilibrium between supply and demand, transportation system equilibrium; Elasticity – direct and cross; concept of consumer surplus; transport demand models – sketch planning, incremental demand model, model estimation from traffic counts; transportation cost, travel – market equilibrium.
5. **Sustainable Transportation Planning:** Sustainable transportation – issues and principles; non-motorized transportation planning; Impact evaluation and impact models.

Suggested Books:

S. No.	Authors / Title / / Publisher	Year of publication
1	Marvin L Manheim, "Fundamentals of Transportation Systems Analysis", The MIT Press, Cambridge, Massachusetts	1980
2	Adib Kanafani, "Transportation Demand Analysis", McGraw Hill Inc, New York, U.S.A.	1983
3	Steenbrink, P.A., Optimization of Transport Network, John Wiley & Sons, NY.	1974
4	Konstadinos G Goulias, "Transportation System Planning – Methods and Applications", CRC Press, London	2002
5	C Jotin Khisty and B Kent Lall, "Transportation Engineering – An Introduction", Prentice Hall of India Pvt Ltd., New Delhi	2003
6	Thomas A Domencich and Daniel McFadden, "Urban Travel Demand – A Behavioural Analysis", North-Holland Publishing Company, Amsterdam	1975

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INSTITUTE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Teaching & Scheme of Examination for M.Tech (Transportation Engineering)

EFFECTIVE FROM ACADEMICSESSION 2019-2021

Year: I **Semester: IV**

S. No.	Subject Code	Subject Name	Hrs./Week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/ Min. Pass Marks	External/ Min. Pass Marks	Total/Min. Pass Marks
Practical's									
1	MTE-401	Dissertation Stage-I	-	-	3	3	200/80	300/120	500/200
Total			**3**		**3**				**500**
Total Teaching Load			**3**						