# M. Tech. Course Structure for Transportation Engineering

(Modified for July 2011 Onwards)

## SEMESTER-1

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L - T - P - C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 581</td>
<td>Urban Transportation Systems Planning</td>
<td>3 - 0 - 0 - 6</td>
</tr>
<tr>
<td>CE 582</td>
<td>Pavements Materials</td>
<td>3 - 0 - 2 - 8</td>
</tr>
<tr>
<td>CE xxx</td>
<td>Elective I</td>
<td>3 - 0 - 0 - 6</td>
</tr>
<tr>
<td>CE xxx</td>
<td>Elective II</td>
<td>3 - 0 - 0 - 6</td>
</tr>
</tbody>
</table>

Total Credits in First Semester: 12 - 0 - 2 - 26

## SEMESTER-2

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L - T - P - C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 583</td>
<td>Pavement Analysis and Design</td>
<td>3 - 0 - 0 - 6</td>
</tr>
<tr>
<td>CE 584</td>
<td>Traffic Engineering</td>
<td>3 - 0 - 2 - 8</td>
</tr>
<tr>
<td>CE 585</td>
<td>Credit Seminar</td>
<td>3 - 0 - 0 - 6</td>
</tr>
<tr>
<td>CE xxx</td>
<td>Elective III</td>
<td>0 - 0 - 2 - 2</td>
</tr>
<tr>
<td>CE xxx</td>
<td>Elective IV</td>
<td>3 - 0 - 0 - 6</td>
</tr>
</tbody>
</table>

Total Credits in Second Semester: 12 - 0 - 4 - 28

## SEMESTER-3

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L - T - P - C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 692</td>
<td>Project and Thesis Phase I</td>
<td>0 - 0 - 24 - 24</td>
</tr>
</tbody>
</table>

## SEMESTER-4

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L - T - P - C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 693</td>
<td>Project and Thesis Phase II</td>
<td>0 - 0 - 24 - 24</td>
</tr>
</tbody>
</table>

Total Credits: 24 - 0 - 54 - 102
**LIST OF ELECTIVES**

**Elective- I**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 502</td>
<td>Classical matrix methods for structural analysis and introduction to FEM</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 601</td>
<td>Numerical Methods</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 602</td>
<td>Optimization Methods</td>
<td>3-0-0-6</td>
</tr>
</tbody>
</table>

**Elective-II,III,IV**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 517</td>
<td>Design and construction of rural roads</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 621</td>
<td>Bridge Engineering</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 622</td>
<td>Geometric Design of Transportation Facilities</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 623</td>
<td>Pavement Evaluation, Rehabilitation and Maintenance</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 624</td>
<td>Highway Construction Practice</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 625</td>
<td>Transportation System Management</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 626</td>
<td>Economic Evaluation and Analysis of Transportation Projects</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 627</td>
<td>GIS and RS in Transportation Engineering</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 628</td>
<td>Traffic Flow Modelling and Simulation</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 629</td>
<td>Public Transportation Systems Planning</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 648</td>
<td>Applied Soil Mechanics</td>
<td>3-0-0-6</td>
</tr>
<tr>
<td>CE 649</td>
<td>Ground Improvement Techniques</td>
<td>3-0-0-6</td>
</tr>
</tbody>
</table>
DETAILS OF THE COURSE CURRICULUM

CE 581  Urban Transportation Systems Planning  (3 0 0 6)

Pre-requisites: Nil

Introduction to transportation planning; systems approach to transportation planning; types of models; concept of travel demand and supply; socio-economic, land use, network, and transport system characteristics affecting transportation planning; study area definition, zoning principles, cordon and screen lines, data collection through primary and secondary sources, sampling techniques; four-stage sequential modeling approach; trip generation; trip distribution; modal split; trip assignment; land use-transport models; public transport planning, integration of different modes; travel demand management measures; case studies.

Texts:

References:

CE 582  Pavements Materials  (3 0 2 8)

Pre-requisites: Nil

Road making aggregates – classification, properties of aggregates, design of aggregate gradation; Bituminous road binders – penetration grade, emulsions, cut backs and modified binders; rheology of bituminous binders, modified binders; mix design – Marshall method and Superpave procedure; design of emulsified mixes, visco-elastic and fatigue properties of bituminous mixtures, resilient modulus of pavement materials; requirements of paving concrete, design of mixes for recycling of bituminous and concrete pavement surfaces; soil stabilization techniques.
Texts:

References:

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CE 583 Pavement Analysis and Design (3 0 0 6)

Pre-requisites: Nil

Philosophy of design of flexible and rigid pavements, analysis of pavements using different analytical methods, selection of pavement design input parameters – traffic loading and volume, material characterization, drainage, failure criteria, reliability, design of flexible and rigid pavements using different methods, comparison of different pavement design approaches, design of overlays and drainage system.

Texts:

References:

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CE 584 Traffic Engineering (3 0 2 8)

Pre-requisites: Nil

Driver behaviour, traffic information and control systems, traffic studies- volume, speed and delay studies, elements of traffic flow theory, characteristics of uninterrupted traffic, capacity
and LOS of Uninterrupted facilities, characteristics of interrupted traffic, traffic characteristics at unsignalised intersections, design of signalized intersections, capacity and LOS of signalized intersections, actuated signal control, signal coordination, design of parking, lighting and terminal facilities, simulation of traffic systems, statistics and probability in traffic engineering, trends in traffic engineering.

**Texts:**

**References:**

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**CE 502 Classical Matrix Methods for structural analysis and Introduction to FEM**

**(3 0 0 6)**

*Pre-requisites: Nil*

Basic approaches of structural analysis, stiffness and flexibility method, stiffness and flexibility coefficients, derivation of stiffness matrix of skeletal member under axial, bending and torsion; assembly of stiffness matrix, storage scheme, band width minimization, skyline storage; solution of algebraic equations, truss, plane frame, grid, space frame, treatment of boundary conditions- penalty function and Lagrange multiplier techniques, condensation and sub-structuring, flexible connection and finite size joints, symmetry and anti-symmetry, concepts of re-analysis, derivation of stiffness matrix for axial members of variable cross section; Rayleigh-Ritz principle, introduction to FDM and FEM; advantages of FEM, comparison between FEM and FDM, concept of discretization of structures and shape function, plane stress, plane strain problems, Lagrangian and serendipity elements, Isoparametric formulation, numerical integration and order of integration, criteria for convergence, computer implementations of algorithms.
Texts:

References:

CE 517  Design and Construction of Rural Roads  (3 0 0 6)

Pre-requisites: Nil

Rural Road Development; Introduction to Rural Road Construction Scheme in India and its Objectives; Classifications of Roads; Importance of Rural Road Connectivity; Planning of Rural Roads Core Network; Preparation of DPR; Specification of Rural Roads; Use of Alternate Materials in Rural Roads; Construction Methods and Techniques Used in Rural Roads; Quality Control in Rural Road Construction Projects; Maintenance of Rural Roads.

Texts:

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CE 601  **Numerical Methods**  

*Pre-requisites: Nil*

Linear equations and eigen value problems, Accuracy of approximate calculations, Nonlinear equations, interpolation, differentiation and evaluation of single and multiple integrals, initial and boundary value problems by finite difference method, Newton’s method, variation and weighted residual methods, introduction to finite element methods, fundamental of statistical distribution.

**Texts:**

**References:**

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CE 602  **Optimization Methods**  

*Pre-requisites: Nil*

Basics of engineering analysis and design, need for optimal design, formulation of optimal design problems, basic difficulties associated with solution of optimal problems, classical optimization methods, necessary and sufficient optimality criteria for unconstrained and constrained problems, Kuhn-Tucker conditions, global optimality and convex analysis, linear optimal problems, Simplex method, Introduction to Karmarkar’s algorithm; numerical methods for nonlinear unconstrained and constrained problems, sensitivity analysis, linear post optimal analysis, sensitivity analysis of discrete and distributed systems; introduction to variational methods of sensitivity analysis, shape sensitivity, introduction to integer programming, dynamic programming, stochastic programming and geometric programming, introduction to genetic algorithm and simulated annealing.
CE 621 Bridge Engineering  

Pre-requisites: Nil

Investigation and site selection, hydraulic factors, alignment, traffic aspects, types of bridges; loading standard, IRC specification, impact factor, general design consideration, structural design of highway and railway bridges in masonry, reinforced, pre-stressed concrete and steel; superstructures: slab bridge, beam and slab bridge, plate girder and composite bridges, bearings and expansion joints, bridge foundation: types of foundation, design of well and pile foundation, bridge vibration: traffic loading, seismic and wind effect, construction techniques and maintenance.

Texts:

References:
2. L. Fryba, Dynamics of Railway Bridges, Thomas Telford, 1996.

CE 622 Geometric Design of Transportation Facilities  

Pre-requisites: Nil

Geometric design provisions for various transportation facilities as per AASHTO, IRC and other guidelines; discussion of controls governing geometric design, route layout and selection, elements of design – sight distances, horizontal alignment, transition curves, super elevation and side friction; vertical alignment: - grades, crest and sag curves; highway cross-sectional elements and their design for rural highways, urban streets and hill roads; at-grade inter-sections – sight distance consideration and principles of design, channelisation, mini
round-abouts, layout of round-abouts, Inter-changes: major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes, bicycle and pedestrian facility design; parking layout and design; terminal layout and design.

Texts:

References:

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CE 623    Pavement Evaluation, Rehabilitation and Maintenance    (3 0 0 6)

Pre-requisites: Nil

Types of pavement distress, techniques for functional and structural evaluation of pavements, network and project survey and evaluation, pavement rehabilitation techniques, overlay design procedures, recycling of flexible and rigid pavements, maintenance of paved and unpaved roads, pavement management systems.

Texts:

References:

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CE 624    Highway Construction Practice    (3 0 0 6)

Pre-requisites: Nil

Embankment, formation cutting in soil and hard rock, sub grade; ground improvement; retaining walls on hill roads; granular & stabilized sub bases/bases; bituminous surfacing; recycled pavements; concrete roads; non conventional pavements; road construction equipments.
Texts:
1. MOST, Specifications for Road and Bridge Work (4th Revision), Ministry of Road Transport and Highways, 2001.

References:

CE 625  Transportation System Management  (3 0 0 6)

Pre-requisites: Nil

Quick response travel evaluation procedure, TSM actions: traffic management techniques for improving vehicular flow, preferential treatment for high occupancy modes, bus priority measures, demand management techniques for reducing traffic demand, staggered hours, and vehicle restrictions; small area management: individual sites, residential neighborhoods, planning for pedestrians, parking planning, traffic calming; travel demand management and telemetries in travel planning.

Texts:

References:

CE 626  Economic Evaluation and Analysis of Transportation Projects  (3 0 0 6)

Pre-requisites: Nil

Economic analysis of transportation projects, ownership and financing of transport, economic function of transportation, road user and transportation costs, highway finance and taxation, case studies of analysis and evaluation of transportation projects.
Texts:

References:

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### CE 627  Geographical Information System (GIS) and Remote Sensing (RS) in Transportation Engineering  
(3 0 0 6)

**Pre-requisites:** Nil

Concept of GIS and RS; land use and transportation data; data base development; map generation and analysis; transportation network development and algorithms; transportation models and their applications in GIS; GIS-T applications; Intelligent Transport Systems (ITS); some case studies.

**Texts:**

**References:**

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### CE 628  Traffic Flow Modelling and Simulation  
(3 0 0 6)

**Pre-requisites:** Nil

Traffic flow characteristics; deterministic and stochastic models of stream flows; car following models; stability and diffusion phenomena in traffic; Boltzmann models; signalized and unsignalised intersections; coordination and optimization of network of signalized intersections; pedestrian flow problems; fundamentals of traffic simulation modeling;
simulation methodologies and model design; simulation languages; application of macro and micro simulation packages.

**Texts:**

**References:**

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**CE 629 Public Transportation Systems Planning (3006)**

*Pre-requisites: Nil*

Modes of public transportation and application of each to urban travel needs; comparison of transit modes and selection of technology for transit service; transit planning, estimating demand in transit planning studies, demand modeling, development of generalized cost, RP & SP data and analysis techniques; functional design and costing of transit routes, models for planning of transit routes, scheduling; management and operations of transit systems; integrated public transport planning; operational, institutional, and physical integration; models for integrated planning; case studies.

**Texts:**

**References:**
CE 648  Applied Soil Mechanics

Pre-requisites: Nil

Earth pressures and design of retaining walls; theory of arching in soils and its applications in tunnel, conduits, silos; braced excavations and open cuts, Sheet piles and Anchored bulkheads, cofferdams and their design; diaphragm walls, bored pile walls and pre-stressed ground anchors; non-conventional retaining systems, stability analysis and design; earth dams and embankments.

Texts:

References:

CE 649  Ground Improvement Techniques

Pre-requisites: Nil

Engineering properties of soft, weak and compressible deposits; principles of treatment; methods of soil improvement-lime stabilization and injection; thermal, electrical and chemical methods; preloading; dynamic consolidation; vertical drains; granular piles; soil nailing; anchors; grouting; Electro-osmosis; soil freezing; vacuum consolidation, case histories.

Texts:
References: