



**SGT UNIVERSITY**  
**SHREE GURU GOBIND SINGH TRICENTENARY UNIVERSITY**  
**GURGAON, DELHI-NCR**  
*(Established by the Haryana Act No.8 of 2013)*

**Department of Civil Engineering**  
**M. Tech**  
**in**  
**Transportation Engineering**



# SGT University Gurgaon

*Credit Based Scheme w.e.f. 2019-2020*

**Curriculum  
(Scheme of Examination)  
&  
Syllabus for  
M. Tech  
Transportation Engineering  
Batch 2019-20 onwards**



**Scheme of Examination for M. Tech – Transportation Engineering  
Program  
SEMESTER WISE COURSE STRUCTURE**

**First Semester**

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1	13160108	Pavement Materials	4	0	0	4	40	60	100
2	13160109	Urban Transportation System Planning	4	0	0	4	40	60	100
3	13160110	Geometric Design of Transportation Facilities	3	0	0	3	40	60	100
4	13160111	Seminar	0	0	3	2	20	30	50
5	13160112	Pavement Materials Lab	0	0	2	1	20	30	50
6	13160113	Traffic Lab	0	0	2	1	20	30	50
7		Elective I	3	0	0	3	40	60	100
		<b>Total</b>	<b>14</b>	<b>0</b>	<b>7</b>	<b>21</b>	<b>220</b>	<b>330</b>	<b>550</b>

**Second Semester**

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1	13160217	Analysis and Design of Pavement	4	0	0	4	40	60	100
2	13160218	Transport Economics	3	0	0	3	40	60	100
3	13160219	Traffic Engineering and Management	3	0	0	3	40	60	100
4	13160220	Pavement Design Lab	0	0	2	1	20	30	50
5	13160221	Comprehensive viva - voce	0	0	3	2	20	30	50
6		Elective II	3	0	0	3	40	60	100
		<b>Total</b>	<b>13</b>	<b>0</b>	<b>5</b>	<b>16</b>	<b>200</b>	<b>300</b>	<b>500</b>

### Third Semester

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1	13160310	Airport Infrastructure, Planning and Design	4	0	0	4	40	60	100
2		Elective – III	3	0	0	3	40	60	100
	13160314	Design lab	0	0	2	1	20	30	50
	13160315	Thesis - I	0	0	10	10	75	125	200
		<b>Total</b>	<b>7</b>	<b>0</b>	<b>12</b>	<b>18</b>	<b>175</b>	<b>275</b>	<b>450</b>

### Fourth Semester

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1	13160402	Thesis - II	0	0	15	15	130	170	300
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>15</b>	<b>15</b>	<b>130</b>	<b>170</b>	<b>300</b>

**List of Program Electives**

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total	
							Int.	Ext.		
<b>Elective-I</b>										
1	13160114	Bridge Engineering	3	0	0	3	40	60	100	
2	13160115	Construction Project Management & BOT	3	0	0	3	40	60	100	
3	13160116	Ground Improvement	3	0	0	3	40	60	100	
4	13160117	Monte- Carlo Simulation in Engineering	3	0	0	3	40	60	100	
<b>Elective-II</b>										
1	13160222	Highway Construction Practices	3	0	0	3	40	60	100	
2	13160223	Mass and Multimodal Transportation System	3	0	0	3	40	60	100	
3	13160224	Environmental Impact assessment and Auditing	3	0	0	3	40	60	100	
<b>Elective-III</b>										
1	13160311	Pavement Evaluation, Rehabilitation and Maintenance	3	0	0	3	40	60	100	
2	13160312	Rock Mechanics and Tunnelling	3	0	0	3	40	60	100	
3	13160313	Road Traffic Safety	3	0	0	3	40	60	100	
		<b>Total Credits</b> ( <i>students to opt for any 3 courses</i> )	<b>9</b>							

**Total Credit offer= 70**

# **SEMESTER – I**

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Pavement Materials	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160108/13160112	4	0	2		
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
Lectures = 52		Tutorials = 0	Practical = 28			
<b>8. Brief Syllabus</b> Soil composition and structure, Properties and test on road aggregate, Bitumen materials.						
<b>9. Learning objectives:</b> Understanding the strength characteristics of various road materials, the temperature dependency of bitumen and ability to understand the rheological properties of bitumen.						
<b>10. Course Outcomes (COs):</b> At the end of the course, the student will be able to						
1. Strength characteristics of various road materials,						
2. Behaviour of road binding materials.						
3. Scope for the new road materials						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Subgrade soil</b>				
Soil composition and structure - Soil classification for engineering purposes - Origin, Classification, requirements.						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Aggregates</b>				
Properties and tests on road aggregates, Aggregate classification, Volumetric analysis of aggregate.						
<b>Unit - 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Bituminous materials</b>				
Origin, preparation, properties and tests, constituent of bituminous (road binders), Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests.						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Bituminous Mix</b>				
Mechanical properties - Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. Weathering and Durability of Bituminous Materials and Mixes - Performance based Bitumen Specifications – Super pave mix design method.						
<b>Unit - 5</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Cement concrete for pavement construction</b>				
Requirements, design of mix for CC pavement, joint filler and sealer materials.						
<b>12. Books Recommended (3 Text Books + 2-3 Reference Books)</b>						
i)	S.K. Khanna & C.E.G. Justo, Highway Engineering, Namechand & Bros. publication					
ii)	S.K. Khanna & C.E.G. Justo, Highway Materials And Pavement Testing, Namechand & Bros. publication					
iii)	Martin Rogers and Bernard Enright, Highway Engineering, Wiley publication					

iv)	IRC, “Steel Fibre Reinforced Concrete for Pavements”, IRC: SP – 46, 1997, Indian Road Congress.	
v)	Westergaard, H.M. “ Stress in Concrete Pavements Computed by Theoretical Analysis”	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Mechanical properties of road materials	1
2	Mechanical and rheological properties of binding materials	2
3	Case study on new road materials	3
<b>14. Lab Components</b>		
<b>Sr. No.</b>	<b>Topic</b>	<b>CO covered</b>
1	Tests on Soil (Grain size analysis - Wet sieve analysis, Liquid limit, plastic limit & Shrinkage limit, Compaction test, California bearing ratio test )	1
2	Tests on Aggregate (Shape tests - Elongation, Flakiness Index & Combined Index, Aggregate impact value test, Los Angeles abrasion value test, Specific gravity & Water absorption test )	1
3	Tests on Bituminous (Stripping value test, Ductility test, Flash & fire point test, Penetration test, Viscosity test)	2
4	Tests on Cement & Concrete and modified materials (Fineness, Standard consistency & setting time of cement, Soundness Compressive strength)	3



<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Urban Transportation System Planning	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160109	4	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 52</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b>						
Understanding the travel pattern of urban users, learn to forecast the various traffic and to understand the necessity of mass transit system in urban areas, learn to calculate the efficiency of various mass transit system.						
<b>9. Learning objectives:</b>						
Understanding the travel behavior of road users, planning proper Origin- Destination survey and evaluation of transit mode and its efficiency, Analysis of survey data, Determine the various traffic parameters from the survey.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Strength characteristics of various road materials,						
2. Behaviour of road binding materials.						
3. Scope for the new road materials						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Introduction</b>				
Mass transit systems, Elements / components of transit systems; Urban Mass Transit systems- types, characteristics, suitability and adaptability of these systems; Evolution of urban transportation.						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Transit System Planning</b>				
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.						
<b>Unit - 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Transit Demand Estimation and Evaluation</b>				
Transit demand forecasting; transit mode evaluation; comparison and selection of most suitable transit mode.						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Transit System Operations</b>				
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.						
<b>Unit - 5</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Transit Networks and System Analysis</b>				

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

**12. Books Recommended (3 Text Books + 2-3 Reference Books)**

- i) C A O’Flaherty, ‘Transport Planning and Traffic Engineering’, Butterworth-Heinemann, Burlington
- ii) John W. Dickey and others, “Metropolitan Transportation Planning”, Tata McGraw-Hill Book Company Ltd., New Delhi
- iii) C JotinKhisty and B Kent Lall, “Transportation Engineering” PrenticeHall of India Pvt Ltd., New Delhi

**13. Tutorial / Extended Tutorial /presentation/Case study components**

Sr. No.	Title	CO covered
1	Learn to plan various O-D survey	2
2	Understanding the urban users travel behavior by using various O-D survey	1
3	Learn to forecast ADT, AADT, PHF etc.	2
4	Urban mass transit system suitability analysis	3
5	Capacity of transit lines	3

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Geometric Design of Transportation Facilities	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Course Code</b>	13160110	3	0		3	
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b>						
Understanding the various government guidelines for the geometric design, importance of cross sectional elements and sight distances and curve, learn about the intersection design.						
<b>9. Learning objectives:</b>						
<ol style="list-style-type: none"> <li>1. Learn about the various road design elements.</li> <li>2. Students will be able to understand the importance of sight distances.</li> <li>3. Curves and the various intersection design.</li> </ol>						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
<ol style="list-style-type: none"> <li>1. Understanding the basic road design elements</li> <li>2. Importance of sight distance and curves</li> <li>3. Various intersection design</li> </ol>						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: IRC and AASHTO guidelines for geometric design</b>				
Geometric design provisions for various transportation facilities as per IRC and other guidelines. Discussion of controls governing geometric design, Route layout and selection.						
<b>Unit - 2</b>	<b>Number of lectures = 4</b>	<b>Title of the unit: Cross sectional elements of highway</b>				
Pavements surface characteristics, camber, carriageway width, median, kerbs, road margins, guard rail						
<b>Unit – 3</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Sight distances</b>				
Stopping sight distance, Passing sight distance, overtaking sight distance, headlight sight distance, sight triangle						
<b>Unit - 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Curve design</b>				
Horizontal curve, super elevation, transition curve, vertical curves (summit & valley curve)						
<b>Unit - 5</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Un-signalized intersection at grade</b>				
Sight distance consideration and principles of design, channelization, mini roundabouts, layout of roundabouts, Inter-changes: major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes						
<b>12. Books Recommended (3 Text Books + 2-3 Reference Books)</b>						
i) Relevant IS and IRC codes						

ii)	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Materials and Pavement Testing`, Nem Chand and Bros, Roorkee
iii)	AASHTO Green Book, 2001
iv)	AASHO, A policy on Geometric Design of Rural Highway, American Association of State highway Officials; Washington
v)	Matson, T.M., Smith, W.S., Hurd, H.W. Traffic Engineering, McGraw Hill Book Co. Inc., New York.

**13. Tutorial / Extended Tutorial /presentation/Case study components**

Sr. No.	Title	CO covered
1	Cross sectional drawing and marking of various elements of design with standard value for highway	1
2	PPT presentation on various government guidelines for geometric design	3
3	Sight distances calculation	2
4	Roundabout design	3
5	Horizontal and vertical alignment design	2

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Traffic Lab	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160113	0	0	2		
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 0</b>		<b>Tutorials = 0</b>	<b>Practical = 28</b>			
<b>8. Learning objectives:</b>						
1. Students will understand the importance of traffic studies and traffic forecasting and how important it is for proper efficiency of any transport facility.						
2. Students able to understand that how to determine the speed criteria.						
3. Accidents analysis and mitigation						
<b>9. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Understanding the ADT & AADT calculation from various techniques						
2. Parking studies						
3. Accidents analysis using videography						
<b>10. Lab Components</b>						
<b>Sr. No.</b>	<b>Topic</b>					<b>CO covered</b>
1	Traffic volume study using videography technique.					1
2	Traffic speed study using videography technique.					1
3	Speed study by radar gun & endoscope					1
4	Determination of reaction time of driver					1
5	Parking study					2
6	Accident investigation study					3
7	Study for improvement of an accident prone location					3

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Bridge Engineering	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160114	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ()	<b>PE</b> (✓)		<b>OE</b> ()	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
Lectures = 40		Tutorials = 0	Practical = 0			
<b>8. Brief Syllabus</b> Bridge Aesthetics, Analyzing techniques, Prestress concrete, Steel bridge, Bridge in service.						
<b>9. Learning objectives:</b>						
1. Various structural elements of bridge.						
2. Students will be able to understand the various types of loading used for bridge analysis like Class A loading, 70R loading.						
3. Steel structure analysis.						
4. Maintenance of bridge.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Understanding the importance of bridge aesthetics						
2. Understanding the various components and their importance in bridge						
3. Understanding the various kind of loading on bridge						
4. Use of concrete and steel bridge and their maintenance						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Introduction &amp; Bridge Aesthetics</b>				
Introduction, Planning, Aesthetics and Bridge, Road bridges, Loading and IRC codes						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Analyzing techniques</b>				
Slab Bridges and RCC T Beam Bridges, Different analysis techniques-finite element, finite strip, finite difference. Grillage analysis						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Prestress concrete</b>				
Pre-stressed Concrete I Girder Bridges, Box Girder Bridges and Segmental Box Girder Bridges, Substructures including Abutments						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Steel bridge</b>				
Railway Bridges and IRS codes , Steel bridges: Truss Bridges and Plate Girder Bridges						
<b>Unit - 5</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Bridge in service</b>				
Bridge Commissioning, Maintenance and Closure						
<b>12. Books Recommended (3 Text Books + 2-3 Reference Books)</b>						
i) Relevant IRC & IRS codes						
ii) N. Krishna Raju, “Design of Bridge”, Oxford & Ibh. (ISBN 8120417984)						
iii) Johnson Victor,” Essentials Of Bridge Engineering”, Oxford & Ibh, 2016						
iv) Krishna Raju, “Prestressed Concrete”, McGraw Hill Education; Sixth edition						

v) T.Y. Lin, Ned H. Burn, "Design of Prestressed Concrete Structure", Wiley India Private Limited; Third edition

**13. Tutorial / Extended Tutorial /presentation/Case study components**

<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	PPT presentation on bridge aesthetics	1
2	Understanding the various kind of load	3
3	Design of various structural elements of bridge	2
4	Video presentation on bridge assembling	2
5	Maintenance cost discussion	4

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Construction Project Management & BOT	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160115	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ()	<b>PE</b> (✓)		<b>OE</b> ()	
<b>5. Pre-requisite (if any)</b>	PERT & CPM	<b>6. Frequency (use tick marks)</b>	Even ()	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>	<b>Practical = 0</b>			
<b>8. Brief Syllabus</b> Understanding the various stages of project, Economic and financial analysis of project, Project selection, Network scheduling, Use of computer programs, Project bid, Project operation						
<b>9. Learning objectives:</b>						
1. Students will understand the importance of project management for any infrastructure project.						
2. Overall development of students in how to deal with different – different people involved in the project.						
3. Learn about the use of various software in flow less execution of any infrastructure project,						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Economic & Financial analysis of project, Project selection						
2. Network scheduling						
3. Project execution						
4. Project operation						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Introduction</b>				
Foundations of Project Management, Project Life Cycle, Project Environment, Project Selection, Project Proposal, Project Scope						
<b>Unit - 2</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Project planning</b>				
The Breakdown Structure. Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Assumptions in PERT						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Modelling</b>				
Modelling, Time-cost Trade-offs, Linear Programming and Network Flow Formulations, PERT/COST Accounting.						
<b>Unit - 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Project schedule</b>				
Scheduling with limited resources, Resource Planning, Resource Allocation, Project Schedule Compression, Project Scheduling Software, Precedence Diagrams, Decision						



CPM, Generalized Activity Networks, GERT		
Unit - 5	Number of lectures = 8	Title of the unit: Project execution
Estimation of Project Costs, Earned Value Analysis, Monitoring Project Progress, Project Appraisal and Selection, Recent Trends in Project Management		
<b>12. Books Recommended (3 Text Books + 2-3 Reference Books)</b>		
i)	Projects: Planning, Analysis, Selection, Implementation & Review, Prasanna Chandra, 5th Ed., 2002.	
ii)	Project Management: A systems approach to planning and controlling, Harold Kerzner, CBS Publisher, New Delhi, 2nd Ed., 2000.	
iii)	Lock, D., 2003, Project Management, 8 <sup>th</sup> edition, Gower Publishing Limited	
iv)	Project KickStart, <a href="http://www.projectkickstart.com">http://www.projectkickstart.com</a>	
v)	AMS REALTIME projects, <a href="http://www.amsrealtime.com/products/project.htm">http://www.amsrealtime.com/products/project.htm</a>	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Project economic & financial analysis ppt presentation	1
2	Critical path analysis	2
3	Owners client relationship case studies	1,2,3,4
4	Computer modeling	3
5	Project operation	4

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Ground Improvement	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160116	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core ()</b>	<b>PE(✓)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Soil Mechanics, Rock Mechanics	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>	<b>Practical = 0</b>			
<b>8. Brief Syllabus</b> Understanding the mechanical behavior of various soils, soil stabilization techniques and deep exploration.						
<b>9. Learning objectives:</b> 1. Properties of various soil deposit. 2. Students will be able to understand that how these stabilization techniques work. 3. Understand about the deep exploration.						
<b>10. Course Outcomes (COs):</b> At the end of the course, the student will be able to 1. Understanding the subgrade soil behavior by using various test like CBR, Triaxial test etc. 2. Various techniques for the soil stabilization/improvement like mechanical, hydraulic etc. 3. Deep exploration.						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Properties of various soil deposit</b>				
Engineering properties of soft – weak and compressible deposits – problems associated with weak deposit – Requirements of ground improvements – introduction to engineering ground modification, need and objectives.						
<b>Unit - 2</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Soil stabilization</b>				
Science of soil stabilization – Mechanical modification – Hydraulic modification – Dewatering systems – Chemical modification – Modification by admixtures like lime, Cement, Bitumen etc. – Grouting – Deep jet mixing methods						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Ground improvement techniques</b>				
Recent Ground improvement techniques: stabilization using industrial waste – modification by inclusion and confinement – soil nailing – stone column – compaction piles – dynamic compaction – prefabricated vertical drains – preloading – electro – osmosis – soil freezing vacuum consolidation – deep explosion – dry powdered polymers - enzymes						
<b>Unit - 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Soil reinforcement</b>				
Historical background, RCC – concept of reinforced earth – Mechanisms – Types of reinforcements – Soil – Reinforcement – Interaction studies – Internal & External stability criteria – Design Principles of steep reinforced soil slopes – pavements – Embankments on						

soft soils.		
<b>Unit - 5</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Geo-Synthetics</b>
Geo-synthetic clay liner – Construction details – Geo Synthetic Materials – Functions – Property characterization – Testing Methods for Geo – Synthetics – Recent research and Developments. Control of Improvement – Field Instrumentation – design and analysis for bearing capacity and settlement of improved deposits.		
<b>12. Books Recommended (3 Text Books + 2-3 Reference Books)</b>		
i)	Hausmann, M.R., Engineering Principles of Ground Modification, McGraw – Hill International Editions, 1990.	
ii)	Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi .	
iii)	Jones C. J. F. P, Earth Reinforcement and Soil Structures, Butterworths, London	
iv)	PCA, Soil-cement Laboratory Hand Book, Portland cement association, Chicago	
v)	Moreland, H. and Mitchell, H. “Lime Soil Mixture” Highway Research Board Bulletin 304, 1961.	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Various soil deposits in India.	1
2	Soil exploration techniques	3
3	Soil stabilizing techniques	2
4	Deep exploration	2
5	Synthetic polymer uses in soil improvement	3

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Monte-Carlo Simulation in Engineering	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160117	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core ()</b>	<b>PE(✓)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Calculus, Probability & Statistics	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b>						
Understand the use of Monte Carlo simulation in engineering, Random and continuous variables, Probability and statics applications.						
<b>9. Learning objectives:</b>						
1. Students will appreciate the importance of Mathematical Tools available for engineering problems.						
2. Learn about the use of differential and integral in analysis						
3. Usefulness of Monte Carlo simulation						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Monte Carlo simulation use in engineering						
2. Probability and statics in structure analysis						
3. Differential & integral use in element analysis						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Basic probability &amp; statistics</b>				
Monte Carlo Simulations in Engineering: Basics of probability and statistics; Random variables						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Random number</b>				
Random number generation – multiplicative congruential generators, tests for pseudorandom sequences, inversion method, acceptance rejection method, discrete and continuous random deviates; variance reduction techniques						
<b>Unit – 3</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Monte Carlo Application</b>				
Application of Monte Carlo simulations to various problems of engineering interest, sampled formed						
<b>Unit - 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Integral calculus</b>				
Numerical integration, reliability engineering, financial engineering, meteorology, statistical mechanics, queuing, random walk.						
<b>Unit - 5</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Differential calculus</b>				
Stochastic differential calculus						
<b>12. Books Recommended</b>						
i) The Monte Carlo Simulation Method for System Reliability and Risk Analysis, Enrica Zio, Springer Publication						

ii) Markov Chains: Gibbs Fields, Monte Carlo Simulation, and Queues, Pierre Bremaud		
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Simulation using Monte Carlo techniques	1
2	Random element understanding	2
3	Differential calculus	3
4	Integral calculus	3
5	Numerical integration	3

# **SEMESTER – II**

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Analysis and Design of Pavement	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160217/13160220	4	0	2		
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ()	<b>PE</b> (✓)		<b>OE</b> ()	
<b>5. Pre-requisite (if any)</b>	Pavement Materials	<b>6. Frequency (use tick marks)</b>	Even (✓)	Odd ()	Either Sem (✓)	Every Sem ()
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
Lectures = 52		Tutorials = 0	Practical = 28			
<b>8. Brief Syllabus</b>						
Understanding the effect of various environmental factors effecting the pavement design, Traffic load calculation, Design and analysis of flexible and rigid pavement.						
<b>9. Learning objectives:</b>						
1. Students will learn about the behavior of various material under various environmental conditions.						
2. Design philosophy of flexible pavement						
3. Design philosophy of rigid pavement						
4. Analysis of flexible and rigid pavement						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Ability to analyses of the pavement.						
2. Ability to design flexible pavement by various methods.						
3. Ability to design rigid pavement by various methods.						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Factors effecting the pavement</b>				
Types and component of pavements, Factors affecting design and performance of pavements. Highway and airport pavements, functions of pavement components						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Load calculation for pavement design</b>				
Design wheel load, strength characteristics of pavement materials, climatic variations, traffic - load equivalence factors and equivalent wheel loads, aircraft loading, gear configuration and tyre pressure. Drainage – Estimation of flow, surface drainage, sub-surface drainage systems, design of sub-surface drainage structures						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Flexible Pavement Design</b>				
Empirical, semi-empirical and theoretical approaches, design of highway and airport pavements by IRC, AASHTO Methods, applications of pavement design software						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Software use in Pavement Design &amp; Analysis</b>				
Types of joints and their functions, joint spacing; design of CC pavement for roads, highways and airports as per IRC, AASHTO, design of joints. Design of continuously reinforced concrete pavements. Reliability; Use of software for rigid pavement design						

<b>Unit - 5</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Software use in Pavement Design &amp; Analysis</b>
IITPAVE, IITRIGID		
<b>12. Books Recommended (3 Text Books + 2-3 Reference Books)</b>		
i)	Yoder and Witczak, Principles of Pavement Design, John Wiley and Sons	
ii)	Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc.	
iii)	Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press (Taylor and Francis Group)	
iv)	W.Ronald Hudson, Ralph Haas and Zeniswki , Modern Pavement Management, McGraw Hill and Co	
v)	Relevant IRC Codes	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Environment effecting the pavement design	1
2	Load calculation for highway pavement design	1
3	Design and analysis of flexible pavement	2
4	Design and analysis of rigid pavement	3
5	Software use in the design & and analysis of pavements	2,3
<b>14. Lab component (Pavement Design Lab)</b>		
<b>Sl. No.</b>	<b>Topic</b>	<b>CO Covered</b>
1	Soil-Cement / Soil-lime Mix Design	3
2	Blending of aggregates	1
3	Design and blending of sub-base material	1
4	Characterization of Aggregate and Bituminous materials	2
5	Visco-elastic Characteristics of bituminous and modified binders	2
6	Modified Marshall test for bituminous mixes	3
7	Repeated Load Testing of pavement materials	3



<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Transport Economics	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160218	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>	<b>Practical = 0</b>			
<b>8. Brief Syllabus</b>						
Understanding the supply, demand and surplus, determinant of elasticity, Transportation cost calculation and economic analysis of project.						
<b>9. Learning objectives:</b>						
1. Students will be able to understand the economics of road projects.						
2. Students will learn about the concept of elasticity and how it affects the supply demand.						
3. Students will understand the governing factors for the choice of travel mode.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Understanding the basic economics term like elasticity, supply, demand etc.						
2. Understanding the surplus						
3. Travel behavior analysis						
4. Economic and financial analysis of highway project.						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Demand</b>				
Transportation economics, Transportation demand, Demand classification, Determinants of demand, Demand function curve, shift in demand curve, Temporal variation of transportation demand and peak problem and measures to mitigate, Price elasticity of demand, Price elasticity of linear demand curve, CRAFT model, Direct and cross elasticity.						
<b>Unit - 2</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Demand, Supply and Equilibrium</b>				
Supply curve, Determinant of supply, Price elasticity of supply, Determinant of price elasticity of supply, Constant elasticity supply function, Demand supply equilibrium and in-equilibrium.						
<b>Unit – 3</b>	<b>Number of lectures = 5</b>	<b>Title of the unit: Surplus</b>				
Consumer surplus, Change in consumer surplus, Latent demand, Producer surplus, Change in producer surplus, Income elasticity.						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Travel behavior analysis</b>				
Behavior analysis, its objective and application. Travel Behavior Analysis (TBA), Application of TBA, Basic steps of TBA, Design of survey instrument, Data types in behavior analysis, Preference elicitation techniques, Discrete choice experiment,						

Identification of attributes and its levels, Generation of alternatives, Factorial design, Strategies to reduce the size of designs, Efficiency of design, Presentation of choice sets, Design of questionnaires and sampling strategies, Data collection procedure, Organization of data and data base management.		
Unit - 5	Number of lectures = 5	Title of the unit: Economic evaluation of transportation project
Transportation economic analysis, Highway economic analysis – some basic concepts, Total transportation cost, Economic and financial cost.		
<b>12. Books Recommended</b>		
i)	Winfrey, Economic analysis for Highways, International Textbook Company, Pennsylvania, 1969.	
ii)	CRRI, Road User Cost Study in India, New Delhi, 1982	
iii)	IRC, Manual on Economic Evaluation of Highway Projects in India, SP30, 2007	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
Sr. No.	Title	CO covered
1	Elasticity effect on supply-demand	1
2	Economic analysis of project	3
3	Various partnership for project financing	2

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Traffic Engineering and Management	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160219	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even (✓)	Odd ()	Either Sem (✓)	Every Sem ()
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b>						
Elements of traffic engineering, Road user facilities, Elements of road design, Traffic regulation & controls, Grade separated intersection design.						
<b>9. Learning objectives:</b>						
1. Students will learn about the traffic studies, traffic forecasting and interpretation.						
2. Students will learn about the speed study.						
3. Students will learn about the various kind of traffic controls.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Learning various design elements						
2. Understanding the road users, roads and vehicle interaction						
3. Design of traffic regulations and controls						
4. Road safety audit						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Elements of Traffic Engineering</b>				
Road user, vehicle and road way. Vehicle characteristics - IRC standards - Design speed, volume. Highway capacity and levels of service - capacity of urban and rural roads - PCU concept and its limitations						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Road users facilities</b>				
Road user facilities - Parking facilities - Cycle tracks and cycle-ways, Pedestrian facilities. Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies.						
<b>Unit – 3</b>	<b>Number of lectures = 4</b>	<b>Title of the unit: Elements of design</b>				
Alignment - Cross sectional elements - Stopping and passing sight distance. Horizontal curves - Vertical curves. Design problems – Hill Roads.						
<b>Unit - 4</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Traffic regulation and control</b>				
Signs and markings - Traffic System Management - Design of at-grade intersections – Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram – Signal co-ordination.						
<b>Unit - 5</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Grade separated intersections</b>				
Geometric elements for divided and access controlled highways and expressways – Road						

furniture - Street lighting. Traffic Safety – Principles and Practices – Road Safety Audit.

**12. Books Recommended**

- i) ITE Hand Book, Highway Engineering Hand Book, McGraw - Hill.
- ii) AASHTO A Policy on Geometric Design of Highway and Streets
- iii) R. J. Salter and N. B. Hounsel, Highway Traffic Analysis and Design, Macmillan Press Ltd, 1996.
- iv) John Wiley & Sons Inc., ITE Brian, Traffic Engineering handbook

**13. Tutorial / Extended Tutorial /presentation/Case study components**

Sr. No.	Title	CO covered
1	Ppt presentation on various design elements	1
2	Interaction between road users, road and vehicles	2
3	Traffic regulations and controls	3
4	Signal design	3
5	Underpass and overpass design	4

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Highway Construction Practices	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160222	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ()	<b>PE</b> (✓)		<b>OE</b> ()	
<b>5. Pre-requisite (if any)</b>	Soil Mechanics, Foundation Engineering	<b>6. Frequency (use tick marks)</b>	Even (✓)	Odd ()	Either Sem (✓)	Every Sem ()
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>	<b>Practical = 0</b>			
<b>8. Brief Syllabus</b> Embankment construction, WBM & WMM, Dry lean concrete and cement treated base, Concrete road construction, Road construction in mountainous region.						
<b>9. Learning objectives:</b>						
1. Students will learn about the various layers of road and the material used in them for construction.						
2. Construction of road embankment & base.						
3. WBM & WMM construction techniques.						
4. Construction of concrete road.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Ability to prepare road subgrade.						
2. Ability to construct GSB, various types of unbounded base course						
3. Ability to construct various types of binder courses.						
4. Ability to construct concrete road						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Embankment Construction</b>				
Formation cutting in Soil and hard rock, Preparation of Sub grade, Ground improvement, Retaining and Breast walls on hill roads						
<b>Unit - 2</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Granular and Stabilized</b>				
Sub – bases / bases, Water Bound Macadam (WBM), Wet Mix Macadam (WMM), and Cement treated bases, Dry Lean Concrete (DLC).						
<b>Unit – 3</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Bituminous Constructions</b>				
Types of Bituminous Constructions, Interface Treatments, Bituminous Surfacing and wearing Courses for roads and bridge deck slabs, Selection of wearing Course under different Climatic and Traffic conditions, IRC specifications, Construction techniques and Quality Control.						
<b>Unit - 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Concrete road construction</b>				
Test on Concrete mixes, Construction equipment, Method of construction of joints in concrete pavements, Quality Control in Construction of Concrete pavements, Overlay Construction.						

<b>Unit - 5</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Road construction in mountainous areas</b>
Hill Roads Construction: Stability of Slopes, Landslides – Causes and Control measures, Construction of Bituminous and Cement Concrete roads at high altitudes, Hill road drainage, Construction and maintenance problems and remedial measures.		
<b>12. Books Recommended</b>		
i)	Principles & practice of Highway Engg.-Dr. L. R. Kadiyali& Dr. N. B. Lal - Khanna Publishers	
ii)	MOST, Specifications for Road and Bridge Work (4th Revision), Ministry of Road Transport and Highways, 2001.	
iii)	C. A. O' Flaherty, Highways – The Location, Design, Construction, & Maintenance of Pavements, Butterworth Heinemann, 2002.	
iv)	R. N. Hunter, Bituminous Mixtures in Road Construction, Thomas Telford Services Ltd., 1995	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Ground improvement and subgrade preparation	1
2	Sub base preparation	2
3	Unbounded base course	2
4	Bitumen road construction	3
5	Concrete road construction	4

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Mass and Multimodal Transportation System	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160223	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ( )	<b>PE</b> (✓)		<b>OE</b> ( )	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even (✓)	Odd ( )	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b>						
Urban transportation system planning – conceptual aspect, Urban passenger and good movement, Trip generation and modes of choice, Role of mass transportation system and synchronization of multi modes transportation system and various issue in achieving that.						
<b>9. Learning objectives:</b>						
1. The course will give exposure to land-use transport models. After going through the course students shall be able to undertake a complete transportation planning exercise for a city.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Urban trip generation						
2. Network design and traffic assignment						
3. Role of mass transit system						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: General Introduction of City Activities</b>				
Urban Activities System, Classification of Roads, Types of road system, Urban Passenger Transport Modes Classification, Urban goods movement.						
<b>Unit - 2</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Urban Transportation System Planning</b>				
Role of Mass Transportation System, Transit Modes and Characteristics, System Performance, Capacity and Quality of Service, Planning Issues.						
<b>Unit – 3</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Network Design</b>				
Route Determination, Traffic Assignment, Network Design, Mode Choice Modelling Service Policy and Schedule development.						
<b>Unit - 4</b>	<b>Number of lectures = 14</b>	<b>Title of the unit: Issues in Mass Transportation System</b>				
Scheduling: trip generation, blocking, run-cutting and rostering, Priority Measures and their Implementations, Issues and Challenges related to development of Mass Transportation System						
<b>12. Books Recommended</b>						

i)	Ortuzar, J.D.D. and Willumsen, L.G. “Modelling Transport”, John Wiley & Sons, 1990.
ii)	Ben Akiva, M.E. and Lerman, S.R., “Discrete Choice Analysis : Theory and Application to Travel Demand”, The MIT Press, Cambridge, Massachusetts, 1985.
iii)	Hutchinson, B.G., “Principles of Urban Transport Systems Planning”, McGraw Hill Book Company, 1974.
iv)	Kadiyali, L.R., “Traffic Engineering and Transport Planning” Khanna Publishers, New Delhi, 2006.
v)	CTTS for Different Indian Cities.

**13. Tutorial / Extended Tutorial /presentation/Case study components**

Sr. No.	Title	CO covered
1	Trip generation and forecasting studies.	1
2	Mathematical model for rout choice and traffic assignment	2
3	Mass transit system	3



<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Environmental Impact assessment and Auditing	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Course Code</b>	13160224	3	0		0	
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ()	<b>PE</b> (✓)		<b>OE</b> ()	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even (✓)	Odd ()	Either Sem (✓)	Every Sem ()
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b> Understanding the importance of environmental effect of any infrastructure project and evaluating the socio-economic cost of that project, Understanding the various legal guideline to ensure proper evaluation and smooth execution of any project, Use of mathematical Models, Total Impact Assessment, Carbon trading.						
<b>9. Learning objectives:</b> <ol style="list-style-type: none"> <li>1. Students will able to understand the Environment Damaging effects of any infrastructure project and how to minimise that.</li> <li>2. Students will learn about the various legal guidelines for environment safety.</li> <li>3. Students will learn about the use development of various mathematical models for Impact Assessment.</li> <li>4. Concept of Carbon Trading.</li> </ol>						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Recognizing the growing need of civil engineering professionals to be acquainted with the potential environmental risks of infrastructure projects						
2. Their nature, methods of qualitative and quantitative assessments, environmental risk evaluation, risk management and remediation techniques and development of predictive model						
3. The emerging aspects of environmental management including techniques of ecological footprinting and carbon trading will be illustrated.						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: An introduction to Environmental Impact Assessment (EIA)</b>				
Technical and procedural aspects of Environmental Impact assessment, Guidelines and legal aspects of environmental protection.						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Adverse effect of pollution</b>				
General Framework for characterizing environmental dislocation disruption due to pollution						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Applications of Mathematical Theories</b>				

Theory and application of mathematical models:- Mathematical modeling for water quality systems, Stream and Estuarine models for pollution control		
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Socio Economic effect of pollution</b>
Socio economic aspects, Measures of effectiveness of pollution control activities, Inter-sector pollutant transfers, total impact assessment.		
<b>12. Books Recommended</b>		
i)	L. W. Canter, Environmental Impact Assessment, 2nd Ed., McGraw-Hill, 1997	
ii)	P. Judith and G. Eduljee, Environmental Impact Assessment for Waste Treatment and Disposal Facilities, John Wiley & Sons, 1994.	
iii)	G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley & Sons, 2000.	
iv)	K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997.	
v)	R. Welford, Corporate Environmental Management - Systems and Strategies, Universities Press, 1996.	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Class room discussion on the Climate Change agreement and other legal guidelines	2
2	Software use in model development	3

# **SEMESTER – III**

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Airport Infrastructure, Planning and Design	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160310	4	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 52</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b>						
ICAO standard for airport and air traffic operation, Various safety standard for aircraft, Airport components, Zoning laws, Capacity and traffic determination, Runway design, Taxiway design, Marking & signal, Lighting.						
<b>9. Learning objectives:</b>						
1. Students will be able to understand the various airport components						
2. Students will be able to understand the different techniques used for air traffic calculation						
3. Students will learn about the various factors affecting the runway orientation						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Understanding the ICAO standards & regulations						
2. Understanding the various design elements of an airport						
3. Air traffic calculation						
4. Runway design						
5. Runway lighting design						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Classification of airports</b>				
ICAO standards. Planning for airport, airport components, zoning laws.						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Air traffic forecasting</b>				
Various methods of air traffic forecasting, Capacity determination.						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Runways Orientation and Geometric Design</b>				
Runway patterns. Taxiways alignment geometry and turning radius exit taxiways						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Aprons Planning and Design</b>				
Design principles of critical, semi-critical, non-critical airport pavements, and FAA and PCA methods. Airport hangars, their planning and design criteria.						
<b>Unit - 5</b>	<b>Number of lectures = 12</b>	<b>Title of the unit: Airport landscaping</b>				
Grading and drainage general aspects. Airport terminal and amenities. Airport lighting and marking.						
<b>12. Books Recommended</b>						
i) Airport Engineering, N.J. Ashford, P.H. Wright, John Wiley						

ii)	Planning and Design of Airports, R.M. Horonjeff, F.X. McKelvey, W.J Sproule, Seth Young,	
iii)	Airport Planning & Management, Wells, Alexander; Young, Seth, McGraw Hill.	
iv)	TMH International Publishers	
v)	Airport Engineering (Planning and Design), S.C Saxena, CBS Publisher	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	ICAO guidelines presentation	1
2	Traffic forecasting techniques	3
3	Runway direction determination and design problem	2
4	Airport pavement materials discussion	4
5	Airport landscaping, Aesthetics	5

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Design lab	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160314	0	0	2		
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Geometric design, Survey	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
Lectures = 0		Tutorials = 0	Practical = 28			
<b>8. Learning objectives:</b>						
1. MX Road is an excellent string-based modeling tool that enables the rapid and accurate design of all types of roads.						
2. MX Road contributes to improving the quality of designs by combining traditional engineering workflow profile and cross sections with 3D modeling technology.						
<b>9. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Understand the input data required for road design						
2. Understand the surface and excavation work design						
3. Understand the curve design and how to use known theory in the design						
<b>10. Lab Components</b>						
<b>Sr. No.</b>	<b>Topic</b>					<b>CO covered</b>
1	Basic concepts and view control					1
2	Survey input and validation					1
3	String name and drawing style					1
4	Surface checker, string creation and edition					1
5	Surface analysis and earth work calculation					2
6	Alignment creation (horizontal and vertical curve)					3
7	Carriage way design					3
8	Junction design					3

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Thesis – I	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Course Code</b>	13160315	0	0		10	
<b>4. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>		<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Learning objectives:</b>						
<ol style="list-style-type: none"> <li>1. To make literature survey for various recently emerging technologies.</li> <li>2. To select any topic of interest and to review the related literature in detail.</li> <li>3. To compare and analyze the various topologies for the selected topic of interest.</li> <li>4. To conclude the advantages, drawbacks and future scopes of the technique.</li> </ol>						
<b>8. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
<ol style="list-style-type: none"> <li>1. Get familiarity with the recently advanced techniques.</li> <li>2. Get detailed information about the topic of interest.</li> <li>3. Learn thesis writing skills</li> </ol>						

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Pavement evaluation, Rehabilitation & Maintenance	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Course Code</b>	13160311	3	0		0	
<b>4. Type of Course (use tick mark)</b>		<b>Core ()</b>	<b>PE(✓)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>	<b>Practical = 0</b>			
<b>8. Brief Syllabus</b> Pavement distresses, Pavement rehabilitation techniques, Overlay design, Pavement maintenance.						
<b>9. Learning objectives:</b>						
1. Students will able to understand the various types of stresses developed in pavements.						
2. Students will able to understand the causes of the road failure and how to mitigate them to the extent possible.						
3. Students will learn about the overlay design.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Understand the importance of pavement health monitoring.						
2. Understand the importance of overlay design.						
3. Understand the maintenance of paved and unpaved road.						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Pavement distress</b>				
Types of pavement distress, techniques for functional and structural evaluation of pavements.						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Pavement Rehabilitation techniques</b>				
Network and project survey and evaluation, pavement rehabilitation techniques.						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Overlay Design</b>				
Overlay design procedures, recycling of flexible and rigid pavements,						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Road maintenance</b>				
Maintenance of paved and unpaved roads, Pavement management systems.						
<b>12. Books Recommended</b>						
i) Flexible Pavement Rehabilitation and Maintenance, Prithvi S. Kandhal, Mary Stoup Gardiner, American Society for Testing & Materials publication						
ii) Construction and Rehabilitation of Concrete Pavements Under Traffic, Shreenath Rao, Deepak Raghunathan, TRB						



iii) STP1348; Flexible Pavement Rehabilitation and Maintenance		
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Case study on determination of various distresses in road and causes	1
2	Pavement health evaluation techniques ppt.	3
3	Pavement maintenance techniques study	4

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Rock Mechanics and Tunneling	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Course Code</b>	13160312	3	0		0	
<b>4. Type of Course (use tick mark)</b>		<b>Core</b> ()	<b>PE</b> (✓)		<b>OE</b> ()	
<b>5. Pre-requisite (if any)</b>	Soil Mechanics	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>		<b>Practical = 0</b>		
<b>8. Brief Syllabus</b>						
Understanding the supply, demand and surplus, determinant of elasticity, Transportation cost calculation and economic analysis of project.						
<b>9. Learning objectives:</b>						
1. Students will be able to understand the importance of rock mechanics.						
2. Students will be able to understand the tunnel design.						
3. Students will learn about the tunnel construction.						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
1. Learn about the physical and mechanical behavior of intact rock and rock mass						
2. Simple elastic and elastoplastic constitutive models used in rock mechanics						
3. Learn about the tunnel digging						
4. Learn about the modern techniques used for tunneling						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Rock properties</b>				
Introduction - objective, scope and problems of Rock Mechanics. Classification by origin, Lithological, Engineering. Rock exploration - rock coring, geophysical methods. Laboratory testing of rocks - all types of compressive strength, tensile strength and flexural strength tests. Strength and failure of rocks â Griffith s theory, Coulombs theory, rheological methods.						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Deformation characteristics of Rocks</b>				
In-situ tests on rock mass. Deformation characteristics of rocks, instrumentation and measurement of deformation of rocks. Permeability characteristics interstitial water on rocks, unsteady flow of water through jointed rock mass. Mechanical, thermal and electrical properties of rock mass. Correlation between laboratory and field properties.						
<b>Unit – 3</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Pressure tunnel</b>				
Analysis of stresses. Thick wall cylinder, formulae, Kreish equation, Green span method. Openings in rock mass and stresses around openings. Pressure tunnels, development of plastic zone. Rock support needed to avoid plastic deformation. Lined and unlined tunnels. Underground excavation and subsidence.						
<b>Unit - 4</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Rock failure</b>				

Rock mechanics applications. Bearing capacity of homogeneous as well as discontinuous rocks. Support pressure and slip of the joint. Delineation of types of rock failure. Unsupported span of underground openings, pillars. Rock slopes.

<b>Unit - 5</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Tunneling in various subsoil conditions</b>
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Rock bolting. Plastic mechanics. Tunnels, shapes, usages, Methods of Construction, Problems associated with tunnels, tunneling in various subsoil conditions and rocks

**12. Books Recommended**

i)	Goodman, R. E. Introduction to Rock Mechanics. John Wiley and Sons, 1989.
ii)	John Jaeger and N. G. Cook. Fundamentals of Rock Mechanics. Wiley-Blackwell. 2007.
iii)	Ramamurthy, T. Engineering in Rocks for Slopes, Foundations and Tunnels. Prentice Hall India, 2007.
iv)	Transportation Tunnels, 2nd Edition, S. Ponnuswamy, D. Johnson Victor, CRC Press publication

**13. Tutorial / Extended Tutorial /presentation/Case study components**

<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Presentation on various rock strata in India	1
2	Presentation on the modern tunneling techniques	4

<b>1. Name of the Department: Civil Engineering Department</b>						
<b>2. Course Name</b>	Road Traffic Safety	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Course Code</b>	13160313	3	0	0		
<b>4. Type of Course (use tick mark)</b>		<b>Core ()</b>	<b>PE(✓)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Geometric Design & Traffic Engineering	<b>6. Frequency (use tick marks)</b>	Even ( )	Odd (✓)	Either Sem (✓)	Every Sem ( )
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 40</b>		<b>Tutorials = 0</b>	<b>Practical = 0</b>			
<b>8. Brief Syllabus</b> Highway safety, Drivers behavior, Highway safety management system, Crash statistics and road safety audit.						
<b>9. Learning objectives:</b>						
<ol style="list-style-type: none"> <li>1. The course addresses several sub-areas of transportation safety. Proactive and reactive safety planning and design.</li> <li>2. “Hotspot” identification and remediation.</li> <li>3. Human factors considerations in highway safety</li> <li>4. State of the practice analysis methods for evaluating countermeasures.</li> </ol>						
<b>10. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
<ol style="list-style-type: none"> <li>1. Provide students with a working knowledge of traffic safety concepts, covering the range from traffic planning, operations, and design.</li> <li>2. Gain an understanding of safety management systems, different safety countermeasures, statistical issues with countermeasures and their effectiveness, and crash investigation.</li> </ol>						
<b>11. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 6</b>	<b>Title of the unit: Highway Safety</b>				
What is “highway safety”? Driver behavior and crash “causality” Elements of highway safety management systems.						
<b>Unit - 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Safety Countermeasures</b>				
Safety countermeasures Safety management process, Crash reporting and collision diagrams Basics of crash statistics.						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Surplus</b>				
Before-after methods in crash analysis Advanced statistical methods Highway geometry and safety.						
<b>Unit - 4</b>	<b>Number of lectures = 16</b>	<b>Title of the unit: Road safety audit</b>				
Road safety audits, Crash investigation and analysis.						
<b>12. Books Recommended</b>						
i) KW Ogden, Safer Roads: A Guide to Road Safety Engineering, Averbury Technical Press, Ashgate Publishers, 1996.						

ii)	Rune Elvik and Truls Vaa, The Handbook of Road Safety Measures, Elsevier, 2004.	
iii)	Leonard Evans, Traffic Safety, Science Serving Society, 2004.	
iv)	Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997 (reprinted 2002).	
v)	Highway Safety Manual (HSM)	
<b>13. Tutorial / Extended Tutorial /presentation/Case study components</b>		
<b>Sr. No.</b>	<b>Title</b>	<b>CO covered</b>
1	Review paper or project related to road safety	1,2

# **SEMESTER – IV**

<b>9. Name of the Department: Civil Engineering Department</b>						
<b>10. Course Name</b>	Thesis – II	<b>L</b>	<b>T</b>		<b>P</b>	
<b>11. Course Code</b>	13160402	0	0		10	
<b>12. Type of Course (use tick mark)</b>		<b>Core (✓)</b>	<b>PE()</b>		<b>OE()</b>	
<b>13. Pre-requisite (if any)</b>		<b>14. Frequency (use tick marks)</b>	Even (✓)	Odd ()	Either Sem (✓)	Every Sem ()
<b>15. Learning objectives:</b>						
5. To make literature survey for various recently emerging technologies. 6. To select any topic of interest and to review the related literature in detail. 7. To compare and analyze the various topologies for the selected topic of interest. 8. To conclude the advantages, drawbacks and future scopes of the technique.						
<b>16. Course Outcomes (COs):</b>						
At the end of the course, the student will be able to						
4. Get familiarity with the recently advanced techniques.						
5. Get detailed information about the topic of interest.						
6. Learn thesis writing skills						