<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Sessional Marks</th>
<th>Examination Marks</th>
<th>Total</th>
<th>Credit</th>
<th>Duration of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
<td>Theory</td>
<td>Practical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CEH-501</td>
<td>Pavements Design</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>CEH-503</td>
<td>Highway Materials</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>CEH-505</td>
<td>Geometric Design</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>CEH-507</td>
<td>Traffic Engineering</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>CEH-509</td>
<td>Pavements Construction and Maintenance</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>CEH-511</td>
<td>Traffic Engineering Lab</td>
<td>-</td>
<td>3</td>
<td>20</td>
<td>-</td>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>7</td>
<td>CEH-513</td>
<td>Highway Materials Lab</td>
<td>-</td>
<td>3</td>
<td>20</td>
<td>-</td>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>20</td>
<td>6</td>
<td>165</td>
<td>375</td>
<td>60</td>
<td>600</td>
</tr>
</tbody>
</table>

Note: Students will be allowed to use Non-Programmable Scientific Calculator. However, sharing of calculator will not be permitted in the examination.
# M. Tech in CIVIL ENGINEERING (Highway Safety and Engineering) IIInd Semester

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Sessional Marks</th>
<th>Examination Marks</th>
<th>Total</th>
<th>Credit</th>
<th>Duration of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CEH-502</td>
<td>Transport Planning</td>
<td>4 - 25</td>
<td>75</td>
<td>100</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CEH-504</td>
<td>Public Private Partnership concepts in Road Infrastructure</td>
<td>4 - 25</td>
<td>75</td>
<td>-</td>
<td>100</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEH-506</td>
<td>Road Safety and Audit</td>
<td>4 - 25</td>
<td>75</td>
<td>-</td>
<td>100</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEH</td>
<td>Elective-I</td>
<td>4 - 25</td>
<td>75</td>
<td>-</td>
<td>100</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEH</td>
<td>Elective-II</td>
<td>4 - 25</td>
<td>75</td>
<td>-</td>
<td>100</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CEH-508</td>
<td>Road Safety and Audit Lab</td>
<td>- 3</td>
<td>20 -</td>
<td>30</td>
<td>50</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td>20 3</td>
<td>145 375</td>
<td>30</td>
<td>550</td>
<td>21.5</td>
<td></td>
</tr>
</tbody>
</table>

## Elective I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Elective I</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEH-552</td>
<td>Traffic Management and Intelligent Transport Systems</td>
</tr>
<tr>
<td>CEH-554</td>
<td>Systems and Operational Research Methods in Transportation</td>
</tr>
<tr>
<td>CEH-556</td>
<td>Transportation data analysis</td>
</tr>
<tr>
<td>CEH-558</td>
<td>Composite Materials</td>
</tr>
</tbody>
</table>

## Elective II

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Elective II</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEH-572</td>
<td>Mass Transportation Systems</td>
</tr>
<tr>
<td>CEH-574</td>
<td>Advanced Methods in Road and airfield Infrastructure Design</td>
</tr>
<tr>
<td>CEH-576</td>
<td>Low volume Roads</td>
</tr>
<tr>
<td>CEH-578</td>
<td>Highway Sub grade and Foundation Analysis</td>
</tr>
<tr>
<td>CEH-580</td>
<td>Probability and Statistics</td>
</tr>
</tbody>
</table>

Note:
1. Students will be allowed to use Non-Programmable Scientific Calculator. However, sharing of calculator will not be permitted in the examination.
2. The choice of students for any elective shall not be binding on the department.
## M. Tech in CIVIL ENGINEERING (Highway Safety and Engineering) IIIrd Semester

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Examination Marks</th>
<th>Total</th>
<th>Credit</th>
<th>Duration of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
<td>Sessional Marks</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td>1</td>
<td>CEH-601</td>
<td>Environmental and Social Impact Assessment of Highway Projects</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>CEH-603</td>
<td>GIS in Highway Engineering</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>CEH-</td>
<td>Elective-III</td>
<td>4</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>CEH-605</td>
<td>GIS Lab</td>
<td>-</td>
<td>3</td>
<td>20</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>CEH-607</td>
<td>Seminar</td>
<td>-</td>
<td>2</td>
<td>50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>CEH-609</td>
<td>Dissertation(Phase I)</td>
<td>-</td>
<td>6</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>16</td>
<td>11</td>
<td>245</td>
<td>225</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Elective III</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEH-651</td>
<td>Road Transport Regulations and Administration</td>
</tr>
<tr>
<td>CEH-653</td>
<td>Highway Drainage Systems</td>
</tr>
<tr>
<td>CEH-655</td>
<td>Design and construction of bridges and flyovers</td>
</tr>
<tr>
<td>CEH-657</td>
<td>Accident Analysis</td>
</tr>
<tr>
<td>CEH-659</td>
<td>Road Safety and Corridor Management</td>
</tr>
</tbody>
</table>

**Note:**
1. Students will be allowed to use Non-Programmable Scientific Calculator. However, sharing of calculator will not be permitted in the examination.
2. The choice of students for any elective shall not be binding on the department.
3. Dissertation coordinator will be assigned the load of 1 hrs per week excluding his own guiding load. However, the dissertation guiding teacher will be assigned a load of one hr per candidate per week subject to the maximum of two period of teaching load irrespective of number of students/groups under him/her.
### M. Tech IVth Semester (Highway Safety and Engineering)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Sessional Marks</th>
<th>Examination Marks</th>
<th>Total</th>
<th>Credit</th>
<th>Duration of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>P</td>
<td>Theory</td>
<td>Practical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CEH-610</td>
<td>Dissertation</td>
<td>-</td>
<td>20</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>-</td>
<td>20</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>20</td>
</tr>
</tbody>
</table>

**Note:**
1. Dissertation coordinator will be assigned the load of 1 hrs per week excluding his own guiding load. However, the dissertation guiding teacher will be assigned a load of one hr per candidate per week subject to the maximum of two period of teaching load irrespective of number of students/groups under him/her.
UNIT I

Road Pavements and pavement layers - Types of pavements. Flexible and rigid pavements. Components of a pavement and their functions.

Pavement design factors: Factors affecting design of pavements types, functions, choice. Factors affecting design and performance of flexible and rigid pavements: loads - axle load distribution, ESWL, EWL, VDF due to varying loads and traffic conditions.

UNIT II

Subgrade support - CBR and plate bearing tests, Resilient Modulus, fatigue tests, permanent deformation. Pavement material Characteristics, climatic, drainage and environmental factors, their effects and evaluation. Factors affecting design and performance of airport pavements.

Stresses and Deflection/strain in flexible pavements: Application of elastic theory, stresses, deflections/strains in single, two and three layer system, Applications in pavement design.

UNIT III

Design of Flexible Pavements: Empirical, semi empirical and theoretical design approaches, principle, advantages and application. Design steps by CBR method as per IRC. outline of other common methods of Flexible Pavement design such as AASHTO and Asphalt Institute methods, Group Index method, Triaxial method and Burmister’s method.

UNIT VI

Stresses in rigid pavements: Stresses Due to Wheel Loads and Temperature Variations. Westergaard’s theory, critical locations of loading, load and temperature stresses. Critical combination of stresses.


Various types of Overlays, Design of Overlays.

TEXT/REFERENCE BOOKS:

1. Khanna and Justo, “Highway Engineering”- Nem Chand and Bros., Roorkee
3. MoRTH ‘Specifications for Roads and Bridges Works’- Indian Roads Congress
5. Huang, “Pavement Analysis”- Elsevier Publications

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed
UNIT I


Aggregates: Types of road aggregates, Requirements of a good road aggregate, Tests for road aggregates.

UNIT II

Bituminous Materials: Asphalt, Bitumen, Cutback bitumen, Bitumen emulsion, Tar, Road oil, Primers, Manufacturing of bitumen, Functions of bituminous materials, Tests for bituminous materials. 

Portland cement – types, source, functions, requirements, properties, tests and specifications for use in various components of road.

UNIT III

Low Cost Materials: Earth roads, Kankar roads, Gravel roads, Moorum roads, Traffic bound or dry bound macadam, Water bound macadam and water mix macadam.


UNIT IV


Mix design: Proportioning of materials, Requirement of bitumen mixes, design of bituminous mix, Marshall method, Hubbard method, Rothfutch method of bituminous mix design.

TEXT/REFERENCE BOOKS:

1. Khanna and Justo, “Highway Engineering” - Nem Chand and Bros., Roorkee
3. “Soil Mechanics for Road Engineers”- HMSO Publication
4. “Bituminous materials in Road Construction”- HMSO Publication
7. Maintenance, repair, rehabilitation of rigid pavements, IRC: SP 83

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Introduction: Classification of rural highways and urban roads. Objectives and requirements of highway geometric design: Design Control and Criteria.
Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks; Pavement surface characteristics - types, cross slope, skid resistance, unevenness.

UNIT II

Sight distances - types, analysis, factors affecting, measurements, Horizontal alignment--design considerations, stability at curves, super-elevation, widening, transition curves; curvature at intersections.

UNIT III

Vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends.

UNIT IV

Geometric design of cycle tracks, Design of pedestrian subways and over bridges and ramps. Geometric design of parking facilities. Design of Expressways, IRC standards and guidelines for design, Design considerations for rural roads and urban arterials: design speeds, volumes, levels of service and other design considerations.

TEXT/REFERENCE BOOKS:

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers
2. Salter, R.J., Highway Traffic Analysis and Design, ELBS
4. IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I
Traffic Characteristics, road user characteristics - human factors including reaction time and vehicular characteristics affecting road design and traffic flow.
Traffic studies - data collection, analysis and interpretation of results of classified traffic volume, spot speed, speed and delay, origin and destination and parking studies. Sampling in traffic studies. Evaluation of improvement measures by "before and after studies".

UNIT II
Traffic flow characteristics, traffic flow variables, speed – flow – density relationship, PCU values, level of service, factors influencing roadway capacity, capacity of roads at various levels of service, capacity of intersections, Traffic flow theory – scope, relationship between flow variable, bottle necks, Queuing theory and applications; vehicle arrivals, delays at intersections, Elements of simulation technique in traffic Engineering.

UNIT III
Traffic Control Devices: Traffic signs and markings and road lightings. Different types of Traffic islands, channelization; median openings, Delineators, Barriers and other road furniture.
Design of at Grade Intersections: Characteristics and design considerations of at-grade intersections; Rotary intersections; Design of signal phasing.

UNIT IV
Grade separations and interchanges - Types, warrants, adaptability and design details; Interchanges - different types, ramps. Computer applications for intersection and interchange design.
Traffic management techniques: Local area management, Transportation system management. Low cost measures. Various types of medium and long term traffic management measures and their uses, Traffic Calming measures.

TEXT/REFERENCE BOOKS:

4. Khanna and Justo, “Highway Engineering”- Nem Chand and Bros., Roorkee

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Earthwork Machinery: Brief introduction to earthwork machinery: shovel, hoe, clamshell, dragline, bulldozers, cleaning and grubbing, excavation for road and drain, principles of field compaction of embankment/subgrade, compacting equipments.

Construction of Granular and Low Cost Roads: soil stabilization techniques, Construction steps of GSB, WBM and WMM.

UNIT II

Construction of bituminous pavements: various types of bituminous constructions. Prime coat, tack coat, seal coat and surface dressing. Construction of premix carpet, BM, DBM and AC.

Machinery for Construction of Bituminous Roads: bitumen boiler, sprayer, pressure distributer, hot-mix plant, cold-mix plant, tipper trucks, mechanical paver or finisher, rollers. Mastic asphalt. Introduction to various IRC and MORTH specifications.

UNIT III

Construction of cement concrete roads: construction of cement concrete pavements, machinery involved in construction, slip-form pavers, and joints in CC pavements, IRC and MORTH specifications.

Construction of other types of pavements: basic concepts of the following: reinforced cement concrete pavements, prestressed concrete pavements, roller compacted concrete pavements and fibre reinforced concrete pavements. Use of fly ash in cement concrete road construction.

UNIT VI


Special problems in construction & maintenance of hill roads, land slide, causes, investigation, and preventive and remedial measures, protection of embankment and cut slopes. Drainage - Construction of surface and subsurface drainage system for roads. Drainage of urban roads.

TEXT/REFERENCE BOOKS:

1. Khanna and Justo “Highway Engineering” - Nemchand & Bros, Roorkee
4. MoRTH ‘Specifications for Roads and Bridges Works’ - Indian Roads Congress
5. “Soil Mechanics for Road Engineers”- HMSO Publication
6. “Bituminous materials in Road Construction”- HMSO Publication
10. Maintenance, repair, rehabilitation of rigid pavements, IRC: SP 83

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
CEH-511: TRAFFIC ENGINEERING LAB

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>Examinations</th>
<th>Duration of Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1.5</td>
<td>20 Marks</td>
<td>30 Marks</td>
<td>3 Hrs</td>
<td></td>
</tr>
</tbody>
</table>

List of experiments:
1. Traffic volume count
2. Classified traffic volume count
3. Parking study
4. Intersection turning movements
5. Spot speeds
6. Speed and delay Study
7. Study of Performa for Road side interview method
8. Study of Performa for house hold interviews method
9. Before and After studies
10. Study of form A-1
11. Study of form 4

Note:
The students will be required to carry out at least 8 experiments / exercises selecting from the above list and any other two experiments either from the above list or designed by the department based on the theory course.
CEH-513: HIGHWAY MATERIALS LAB

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>20 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1.5</td>
<td></td>
<td>Examinations</td>
<td>30 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration of Exam</td>
<td>3 Hrs</td>
</tr>
</tbody>
</table>

List of Experiments:
1. Granular mix design by Trial and Error Method to achieve the specified gradings
2. Bituminous mix design by Marshall Method
3. Shape test.
4. Water absorption and specific gravity tests.
5. Penetration test.
6. Ductility test.
7. Softening point test.
8. Flash & fire point test.
9. CBR test.

Note:
The students will be required to carry out at least 6 experiments / exercises selecting from the above list and any other two experiments either from the above list or designed by the department based on the theory course.
UNIT I

Transportation Planning Process: Characteristics of different modes of transportation; Elements in urban transit system. Introduction to transport planning, Status of transportation in India, Objectives and scope of transport planning, Urban, regional and national transport planning. Transport planning process, various stages. Land use and transportation planning; zoning and development control exercise; designing for sustainability. Land use transportation models: introduction to Lorry model.

UNIT II

Transport Surveys: Definition of study area. Zoning. Types of surveys. O-D surveys. Inventories of existing transport facilities, land use and economic activities.

Trip Generation: Classification of trips, Factors governing trip generation and attraction; Zonal models; Trip generation estimation by multiple linear regression analysis, brief review of category analysis, advantages and limitations of these methods.

UNIT III

Trip Distribution: Methods of trip distribution. Basic concepts of uniform factor method, average factor method and opportunity model. Trip distribution by gravity model.

Traffic Assignment: principles of traffic assignment; Assignment techniques Principles of assignment. Assignment techniques. All or nothing assignment. Brief review of multipath assignment, capacity restraint assignment and diversion curves.

Modal Split: General considerations for modal split. Factors affecting modal split. Brief Introduction to various methods of modal split.

UNIT IV

Evaluation: Need for evaluation. Several plans to be formulated. Testing. Considerations in evaluation. Economic evaluation, basic principles, brief introduction to various methods of economic evaluation, comparison.

Regional Network Planning: Network Characteristics -- Circuitry, Connectivity, Mobility, Accessibility, Network Structures and Indices -- Network Planning -- Evaluation - Graph Theory Applications

TEXT/REFERENCE BOOKS:

3. Institute of Traffic Engineers – “An Introduction to highway Transportation Engineering”.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Highway Planning in India – Objects, need for highway planning, types of planning, planning surveys, Interpretation, Preparation of Master plans, NTP and NTPC in India. 20 year road development plan including 1st and 2nd 20 year plan in brief and 3rd and 4th 20 year plan in detail. Sources of finance for development and maintenance of road infrastructure. Principles of road use charging, central and state road funds, toll financing and toll policy.

Highway Engineering Economics: principle, supply and demand models, equilibrium, sensitivity of travel demand and elasticity – types, models (Kraft demand model) consumer surplus cost – cost elasticity pricing and subsidy policies, rates of interest, Vehicle operation cost, direct and indirect benefits due to road improvement, Total transportation cost, fixed and variable costs. Road user cost studies in India.

UNIT II

Economic analysis: different methods, determination of annual cost, benefit cost ratio, IRR, FIRR, NPV. Sensitivity of economic analysis, risk and uncertainties and management decision in capital budgeting. Examples of economic analysis for different types of road improvement measures, pavement options, construction of bypasses and upgrading of intersections. Project priorities, methods of dealing with uncertainties.


UNIT III


Procurement of PPP projects: Preparation of Feasibility Reports covering technical, social and environmental aspects (for 2lane/4lane/6lane/Expressway) including procurement of consultancy services. Technical schedules for inviting bids for selection of sponsor. Preparation of RFQ, RFP. Bidding criteria. Selection of sponsor. Award of concessions. Pre-construction activities viz. Land Acquisition, Rehabilitation and resettlement of project affected persons, tree cutting, environment management plan, utilities shifting, etc.

UNIT IV


Contract Management: Principles of contract management for PPP projects. Basic differences between FIDIC conditions of contract and Model Concession Agreement. Selection and Role of Independent Engineer.
Recommended References:
7. “Road User Cost Study in India”- Final Report, Central Road Research Institute, New Delhi, 1982.

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.
Need of Planning for Network, Land Use and Road Environment for Safety, Designing for Safety: Road Link Design, Junctions.

UNIT II

Introduction to Road Safety Engineering and Crash Investigation, Human Factors Relating to Crashes/Accidents, Crash/Accident Investigation & Crash Problem Diagnosing, Crash Problems into Solutions & Crash, Investigation Reporting, Crash/Accident Costing, Economic Appraisal.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT III

Safe System Approach- A Global Perspective, Speed Management & safety, Safe System and Speed & Assessing speed limit, Type of speed limit & Speed zone signing Infrastructure to support safe speed feedback and enforcement.

UNIT IV

Road Safety Auditing: An Introduction, Concept and need of Road Safety Audit (RSA). Procedures in RSA, design standards, audit tasks, stages of road safety audit, Road Safety Audit Types, key legal aspects, process, audit team and requirements, Checklist, how to use Checklists Road Safety inspection. Road design issues in RSA’s. Overview of Road Safety Hazards. Report Writing including deficiency identification, corrective actions recommendations, prioritisation. Structuring RSA report.


TEXT/REFERENCE BOOKS:

1. Highway Engineering by Khanna and Justo, Nem Chand & Brothers, Roorkee
2. BABKOV, V.F. 'Road conditions and Traffic Safety', MIR publications, - 1975.
8. Papacoastas ‘Introduction to Transportation Engineering’ – Prentice
9. Road safety audit Manual

**Note:**

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
List of experiments:

1. Design stage audit: Study of project Drawings to identify safety concerns
2. Site Visits for Construction stage audit
3. Site Visits for existing road audit
4. Site Visits and Preparation of the Audit Reports
5. Visit to accident site
6. Compilation of FIR data and study of its limitations
7. Identification of black spots from FIR data
8. Study of accident recording forms

Note:
The students will be required to carry out at least 6 experiments / exercises selecting from the above list and any other two experiments either from the above list or designed by the department based on the theory course.
UNIT I

Environmental effects of transport; problems of identification; Environmental Impact Assessment: Evaluation of environmental impact due to construction of new facilities and the effect of traffic thereon due to Bypasses, widening/four laning, expressway; grade separators. Assessment and attenuation.

UNIT II

Noise; vibration; air pollution; Air pollution. emission levels, air-pollution dispersion, The box model, noise generation, noise measurement, noise propagation and mitigation strategies, noise measures, mathematical models of transportation noise, energy consumption and related issues. Environmental traffic management. Co-ordinated signal system on urban arterial road intersections to reduce air pollution.

UNIT III

Pedestrian delay and danger; severance; accidents; Visual intrusion and aesthetics; Toxic freight; construction effects.

UNIT IV

Land consumption and land-use effects; planning blight and compensation; Global climate, energy and resource use; and sustainability, GoI policies and requirements for clearances for Road projects.

TEXT/REFERENCE BOOKS:


Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
CEH- 603: GIS IN HIGHWAY ENGINEERING

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>25 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td>Examinations</td>
<td>75 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration of Exam</td>
<td>3 Hrs</td>
</tr>
</tbody>
</table>

UNIT I

Remote sensing: Physics of remote sensing, Ideal remote sensing system, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multiconcept, FCC, Interpretation of remote sensing images.

Digital image processing: Satellite image – characteristics and formats, Image histogram, Introduction to image rectification, Image enhancement, Land use and land cover classification system.

UNIT II

Geographic information system (GIS): Basic concept of geographic data, GIS and its components, Data acquisition, Raster and vector formats, Topography and data models, Spatial modelling, Data output.

Global positioning system (GPS): Introduction, Satellite navigation system, GPS-space segment, Control segment, User segment, GPS satellite signals, Receivers; Static, Kinematic and Differential GPS.

UNIT III

Implementing a GIS: Awareness, Developing System Requirements, Evaluation of alternative systems, System justification and Development of an implementation plan, System acquisition and start up, Operation of the system.

UNIT IV


Applications in Transportation Engineering II: Environmental impact assessment, Transport System Management, Road Network Planning, Collecting Road Inventory.

TEXT/REFERENCE BOOKS:

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
CEH-605: GEOMETIC ENGINEERING LAB

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>20 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examinations 30 Marks
Duration of Exam 3 Hrs

1. Study of Total Station
2. Study of GPS.
3. Study of Aerial photographs.
4. Study and image interpretation of remote sensing data.
5. Introduction to GIS software
6. Introduction to Image Processing Software.
7. To find out shortest route with GIS softwares
8. To find out best route with GIS softwares
9. Black spot identification using GIS
10. Accident analysis using GIS

Note:
The students will be required to carry out at least 8 experiments / exercises selecting from the above list and any other two experiments either from the above list or designed by the department based on the theory course.
CEH – 607: SEMINAR

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>02</td>
<td>02</td>
</tr>
</tbody>
</table>

Class Work : 50 Marks

The objective of this course is

- To learn how to carry out literature search
- To learn the art of technical report writing
- To learn the art of verbal communication with the help of modern presentation techniques

A student will select a topic in emerging areas of Structural Engineering and will carry out the task under the supervision of a teacher assigned by the Department.

He/she will give a seminar talk/presentation on the same topic before a committee constituted by the Chairperson of the Department. The committee should comprise of 2-3 faculty members. The faculty associated in the committee will each be assigned 2hrs teaching load/week. However, supervision of seminar topic will be in addition to the regular teaching load.
The primary objective of this course is to develop in student the capacity for analysis and judgment and the ability to carry out independent investigation in design/development through a dissertation work involving creativity, innovation and ingenuity. The work must start with comprehensive literature search and critical appreciation thereof so as to select research problem the student wishes to work on.

Each student will carry out independent dissertation under the supervision of some teacher(s) who will be called Supervisor(s). In no case more than two supervisors can be associated with one dissertation work.

The dissertation involving design/testing/computer simulation/case studies etc. which commences in the IIIrd semester will be completed in IV semester. The evaluation of the dissertation phase I besides approval of the dissertation topic of the students will done by a committee constituted as under

Chairperson of Department : Chairperson
M.Tech. Coordinator/Sr. Faculty : Member Secretary
Respective dissertation supervisor : Member

The student will be required to submit two copies of his/her report to the Department for record.
CEH-610: DISSERTATION

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>50 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>20</td>
<td>20</td>
<td>Examination</td>
<td>100 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total</td>
<td>150 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration of Examination</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>

The dissertation started in III Semester will be completed in IV Semester and will be evaluated in the following manner.

**Internal Assessment**

Internal Assessment (class work evaluation) will be evaluated as per ordinance through interim report, presentation and discussion thereon by the following committee of three persons

Chairperson of Department : Chairperson
M.Tech. Coordinator/Sr. Faculty : Member Secretary
Respective dissertation supervisor : Member

**External Assessment**

Final dissertation will be assessed by a panel of examiners consisting of the following:

Chairperson of Department : Chairperson
Respective Supervisor(s) : Member(s)
External Expert : To be appointed by the University

Note: The external expert must be from the respective area of specialization. The Chairperson, M.Tech. Coordinator and respective supervisor(s) with mutual consultation will divide the submitted dissertations into groups depending upon the area of specialization and will recommend the list of experts for each group separately to the VC for selecting the examiners with the note that an external expert should be assigned maximum of FIVE dissertations for evaluation.

The student will be required to submit THREE copies of his/her report to the M.Tech Coordinator for record and processing.
CEH- 552: TRAFFIC MANAGEMENT AND INTELLIGENT TRANSPORTATION SYSTEMS

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>25 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td>Examinations</td>
<td>75 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration of Exam</td>
<td>3 Hrs</td>
</tr>
</tbody>
</table>

UNIT I

UNIT II

UNIT III

UNIT IV
Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

TEXT/REFERENCE BOOKS:
1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
CEH- 554 SYSTEMS AND OPERATIONAL RESEARCH METHODS IN TRANSPORTATION

UNIT I
Network flows: Applications, definitions, graphs, paths, trees, cycles, loops, walk, network representation (adjacency list and matrices) and basic network transformations;
Network algorithms; Complexity, Search Algorithms, Strategies for designing polynomial algorithms.

UNIT II
Shortest Path Algorithms: Label setting, Dijkstra’s and Dial’s algorithms, Optimality conditions, label correcting algorithms and optimality conditions, detecting negative cycles, all-pair shortest path algorithms; pre-flow push polynomial time algorithms, capacity scaling techniques.

UNIT III
Minimum cost network assignment: optimality conditions, cycle-cancelling algorithm, Successive shortest path algorithm, other polynomial time variants;
Network equilibrium analysis; principles and optimisation formulations, Frank-Wolfe algorithm;
Special cases and variants.

UNIT IV
Applications: Applications of min-cost, max-flow, and shortest path algorithms to transportation and infrastructure networks: transportation networks, airline, freight, facility location, logistics, network design, project scheduling, reliability of distribution systems, telecommunication/power networks etc. Queuing theory, Computer Software.

TEXT/REFERENCE BOOKS:
3. Operation research by Kanti Swarup, Gupta and Manmohan.
4. Operation research and statistical analysis by S.D.Sharmaonmental impact assessment.

Note:
3. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
4. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I


UNIT II


UNIT III

Concept of Entropy and its Application in Travel Demand Modeling: Definition of Entropy, its relations to Probability and Uncertainty, Entropy of Probability Distribution, Entropy and Bayesian Statistics, Application of Entropy Concepts in Transport Models: Theory of Trip Distribution, Mode Split and Route Split, Production, Attraction, Doubly Constrained Gravity Models and Derivation of Intervening Opportunity Model, Missing Information and Use of Entropy in Travel Demand Modeling: Entropy and Information Theory Approaches for Estimating the Travel Demand using Indirect Methods such as Use of Link Volume Counts, Turning Counts, etc.

UNIT IV

Forecasting using Time Series Analysis: Basic Components of Time Series – Stationery and Non-Stationery Processes- Smoothing and Decomposition Methods – Correlation and Line Spectral Diagrams – Auto Correlations and Moving Averages; Introduction to Box-Jenkins Forecasting

TEXT/REFERENCE BOOKS:
6. Spyros G. Makridakis, Steven C. Wheelwright, Rob J Hyndman, Forecasting : Methods and Applications, Wiley.

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT-1


UNIT-II


UNIT-III

POLYMER CONCRETE: Terminology used in polymer concrete, Properties of constituent materials, Polymer impregnated concrete, Polymer modified concrete, Properties and applications of polymer concrete and polymer impregnated concrete.
FERRO CEMENT: Constituent materials and their properties, Mechanical properties of fero cement, Construction techniques and application of ferro cement.

UNIT-IV

HIGH PERFORMANCE CONCRETE: Materials for high performance concrete, Supplementary cementing materials, Properties and durability of high performance concrete, Introduction to silica fume concrete, Properties and applications of silica fume concrete.
LIGHT WEIGHT CONCRETE: Properties of light weight concretes, Pumice concrete, Aerated cement mortars, No fines concrete, Design and applications of light weight concrete.

References:

1. Concrete Technology-A.M. Nevillie
2. Concrete Technology-M.L. Gambhir.

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.
2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Role of Transportation: History of transit, Recent Trends in transit, Mass transportation characteristics, Demand Characteristics: Spatial, temporal and behavioral characteristics.


UNIT II

Transport system Performance: Performance evaluation and analysis, Structure of decision making, Evaluation and selection methods, and selection procedure.

Generation of alternative schemes, Economic evaluation methods.

UNIT III

Terminals: Public transport infrastructures, Functions of terminals, Design, Typical Terminal characteristics.

Scheduling and Routes: Service analysis, Vehicle dispatch policy, Vehicle Requirements, Spacing of bus stops, Route spacing and performance.

UNIT IV

Management: Operational and management issues in transport planning, integration of public transport modes, Reserved bus lanes and signals, Vehicle monitoring and control system, Nodal coordination. BRT corridors.

Special Systems: Multimodal transport systems, People mover systems, Underground transportation, para transit, Rail transit system, case studies.

TEXT/REFERENCE BOOKS:


Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Introduction: Growth of air transport, airport organization and associations, Classifications of airports airfield components, airport traffic zones and approach areas.

Aircraft Characteristics Related to Airport Design: Components, size turning radius, speed, airport characteristics

UNIT II

Capacity and Delay: Factors affecting capacity, Determination of runway capacity related to delay, gate capacity, taxiway capacity

Airport planning and surveys: Runway length and width, sight distances, longitudinal and transverse grades, runway intersections, taxiways, clearances, aprons, numbering, holding apron.

UNIT III

Design of the Terminal area: Operational concepts, space relationships and area requirements, noise control, vehicular traffic and parking at airports.

Airport Grading and Drainage: Grading of airport area, hydrology, design of drainage systems, construction methods, layout of surface drainage and subsurface drainage system.

UNIT IV

Air Traffic Control and Aids: Runways and taxiways markings, day and night landing aids, airport lighting and other associated aids.

TEXT/REFERENCE BOOKS:

3. “Airport Planning and Design”- Khanna, Arora and Jain, Nem Chand and Bros., Roorkee

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
CEH- 576: LOW VOLUME ROADS

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>25 Marks</th>
<th>Examinations</th>
<th>75 Marks</th>
<th>Duration of Exam 3 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UNIT I

Planning of rural road net work – Concept of core and non-core roads, general principle, guidelines laid down in recent 20-year plans and in PMGSY

Guidelines for alignment and geometric design of rural/low volume roads and safety aspects.

UNIT II

Investigations and surveys, soil and material surveys, Promoting use of alternate marginal / low cost / waste / stabilized local materials in rural road works, fly ash in fill and other layers, use of other waste materials. Soil stabilization methods – mechanical, soil cement, soil lime, soil-lime-pozzolana, soil-lime-cement stabilization

UNIT III

Design of different types of pavements for rural roads, choice of pavement type / pavement materials. Guidelines and specifications by IRC, NRRDA and MORD

Road drainage – study of requirements of surface and subsurface drainage, and cross drains, standard design of culverts and small bridges

UNIT IV

Specifications and steps for the construction of different components of rural / low volume roads including pavement layers, quality control during construction

Maintenance of rural roads – shoulders, side and cross drains. Pavement distress, different types of failures and maintenance measures. Preventive maintenance works.

TEXT/REFERENCE BOOKS:

1. CRRI “Low Volume Roads’ Central Road Research Institute”-New Delhi
3. IRC SP- 26 “Report Containing Recommendations of IRC Regional Workshops on Rural Road Development”- 1984, Indian Roads Congress
6. MoRTH “Specifications for Road and Bridge Works”- 2001, fourth revision, Indian Roads Congress
7. MORD “Specification for Rural roads”
8. MORD “Standard data book for analysis of rates for rural roads”
Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Introduction: Soil Mechanics applications to Highway Engg. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems.

Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure & Engg behavior of compacted cohesive soil, Field compaction specifications Filed compaction control, Different types of Equipments used for compaction, their choice.

UNIT II


Stability of slopes: Introduction, Types, Different methods of analysis of slopes for Øu+0 & C-Ø soil, Location of most critical circle, Earth dam slopes stability, Taylor’s stability number. Effect of Earthquake Force, problems on above.

UNIT III

Permeability of soil: Darcy’s Law, Validity, Soil-water system, Types, Determination of permeability, problems.

Site Investigation: Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

UNIT IV

Highway Drainage: Introduction, Importance, Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system, Road construction in water logged areas, Land slides – definition, classifies, factors producing.

Reinforced Earth structures: Introduction, Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses.

TEXT/REFERENCE BOOKS:

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
CEH-580: PROBABILITY AND STATISTICS

UNIT I

Exponential distribution, Gamma distribution, Beta distribution, and Weibull distribution. Bi-Variate Normal Distribution And The Associated Marginal And Conditional Distributions

UNIT II

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, chi square test, The testing of goodness of fit.

UNIT III

Design and Analysis of Experiments: Fundamental assumptions of analysis of variance, single factor experiments, Latin square and Latin square designs, Design of experiments with several factors- Two factor factorial experiments.
Regression and Correlation Analysis: 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.

UNIT VI

Statistical quality contol: control charts of all types, ISO 9000 Series And Their Importance, operating characteristic Curves, Advantages And Limitations of standard quality limit
Reliability Theory: Theory of Reliabilty, Maintainabilty, Availability, Failure Distribution, State Dependent Systems, Series And Parallel Connections, Redundancy of Systems

Recommended References:

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
CEH- 651: ROAD TRANSPORT REGULATIONS & ADMINISTRATION

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
<th>Credits</th>
<th>Class Work</th>
<th>25 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td>Examinations</td>
<td>75 Marks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Duration of Exam 3 Hrs</strong></td>
<td></td>
</tr>
</tbody>
</table>

UNIT I

Introduction to Traffic regulations and control - Regulation on vehicles, drivers and traffic flow, Traffic control devices – Types & objectives of markings, signs, signals and islands, delineators. Role of M.V. Department in existing road transport scenario in India

UNIT II

Transportation systems - sustainable transport - mobility, accessibility - safety, environment - revenue generation.

M.V. Act and CMV Rules - Implementation issues thereof, Issues in road enforcement, control of traffic, signage.

UNIT III

Transportation planning process and demand forecasting, road safety issues, coordination with other agencies, claims & compensation under MV Act.

Issues in insurance of vehicles, licensing of drivers, taxation of vehicles and passengers, permits under MV Act.

UNIT IV

Inspection/ testing and certification of vehicles. Bus body code & Bus body accreditation system.

Developing customer orientation in M.V. Department functions, RFID based Driving Skill Evaluation system (IDTS)

TEXT/REFERENCE BOOKS:

**Note:**
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

Drainage materials. Methods of maintenance of different types of pavements; Special problems in high rainfall areas. Frost heave

UNIT II

Subgrade Drainage and Earthworks Consolidation
Sub-Base Drainage

UNIT III

Failure Due To Hydraulic Pressure, Failure Due To Binder Stripping, effect of water table variations Drainage of Porous Surface Courses

UNIT IV

Design procedures and IRC Guidelines for Drainage of Urban Roads and maintenance of drainage system Design and construction of surface and sub-surface drainage systems for highways and airports.

TEXT/REFERENCE BOOKS:

1. Highway Engineering by Khanna and Justo, Nem Chand & Brothers, Roorkee
2. Highway Engineering by L.R. Kadyali, Nem Chand & Brothers, Roorkee

Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I


Loads on Bridge: Dead loads, live loads, dynamic effects of vehicles, longitudinal forces, centrifugal forces, wind loads, earth quake forces, stream flow pressure, load combinations, design examples

UNIT II

Design of T beam bridges—balanced cantilever bridges—rigid frame bridges—Arch bridges—bow string girder bridges.

Design of Bridge Slabs: Longitudinally reinforced deck slabs, transversely reinforced bridge slabs

UNIT III

Design of plate girder bridges—steel trussed bridges—Introduction to long span bridges: cable stayed bridges and suspension bridges—instability.

Principles of Planning of Elevated Rail Transit System, grade separation structures, pedestrian crossing and sub-ways.

Forces on piers and abutments—Design of piers and abutments—types of wing walls—types of bearings—design of bearings.

UNIT IV

Design of Prestressed Concrete Bridges: Design code, design examples. Segmental Box bridges—precast sections, criteria, design examples

Sub-Structure Design: Foundation investigation, bearings, bridge pier design, and abutment design. Examples.

TEXT/REFERENCE BOOKS:

5. IRC: 5-1970, Standard specifications and code of practice for road bridges, Sections I to V.
6. 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, 1962.
Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I
Introduction to Road Safety Engineering and Accident Investigation, Factors Relating to Accidents, various forms of recording of accident data, study of IRC recommended recording proforma.

UNIT II
Accident Investigation & Crash Problem Diagnosing: investigation at site, various driver related tests, calculation of post crash speed from skid marks, collision and condition diagrams, and traffic and speed studies.

UNIT III
Accident Costing, Economic Appraisal: various methods of calculation of accident costs, their advantages and disadvantages, case studies.

UNIT VI
Crash Problems into Solutions: research and development in accident analysis, issues and challenges in modeling of road accidents, Smeed’s model, Base line models, General ADT models, Models with covariates, AMFs, various measures to improve road safety, before and after studies.

TEXT/REFERENCE BOOKS:
1. Highway Engineering by Khanna and Justo, Nem Chand & Brothers, Roorkee
4. RRL, DSIR, `Research on Road Safety', HMSO, London.
5. Papacoastas `Introduction to Transportation Engineering’ –Prentice

Note:
1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.
UNIT I

**Congestion:** Management of congested facilities, Expressway and surface streets, types of congestion, key issues in Expressway congestion, congestion issues related to the surface street system, administrative and planning actions, techniques for addressing Expressway system congestion, congestion due to a bottleneck, cumulative demand and capacity, signal remedies in addressing surface street congestion, Expressway surveillance and control.

UNIT II

**Introduction to Expressway Systems:** Expressway as part of highway system, operations and design features of Expressway, capacity analysis of basic freeway sections, capacity analysis of Expressway weaving sections, capacity analysis of ramps and ramp junctions, calibrating relationships for freeway analysis. Non access controlled multilane Highways.

UNIT III

**Expressway Corridor Management:** Management strategies, Components of corridor management, Surveillance and control, Corridor Signage, Building Construction and Land Use, Entrances to Provincial Highways, Encroachments on the Right-of-Way, high occupancy vehicle facilities and incentives, enforcement and control, traffic restrictions, organisational structure, policies and procedure for effective corridor management.

UNIT IV

**Intelligent Vehicle Highway Systems:** Introduction, IVHS programs, role of IVHS in transportation systems of tomorrow, IVHS categories, benefits and costs of IVHS, institutional issues, key considerations. Safety management systems.

**TEXT/REFERENCE BOOKS:**

5. MOST, 'Manual For Safety in Road Design', Ministry of Surface Transport. Govt. of India.
Note:

1. In the semester examination, the examiner will set 08 questions in all selecting two from each unit. The students will be required to attempt only 5 questions selecting at least one question from each unit. All questions will carry equal marks.

2. The use of scientific calculator will be allowed in the examination. However, programmable calculator and cellular phone will not be allowed.