M.Sc. in Construction and Building Engineering

Program Structure

(E) Transportation Engineering

M.Sc. in Construction and Building Engineering

(E) Transportation Engineering

**CORE COURSES:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB 750</td>
<td>Advanced Geometric Design</td>
<td>3</td>
</tr>
<tr>
<td>CB 751</td>
<td>Fundamentals of Traffic Flow Theories</td>
<td>3</td>
</tr>
<tr>
<td>CB 752</td>
<td>Structural Design of Highway and Airport Pavements</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
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**ELECTIVE COURSES: GROUP (1)**

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credit Hours</th>
</tr>
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<tbody>
<tr>
<td>CB 753</td>
<td>Transportation Planning and Management</td>
<td>3</td>
</tr>
<tr>
<td>CB 754</td>
<td>Fundamentals of Railway Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CB 755</td>
<td>Off-the-Road Vehicle Mobility</td>
<td>3</td>
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<tr>
<td>CB 756</td>
<td>Special Topics in Transportation Engineering</td>
<td>3</td>
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<tr>
<td>CB 757</td>
<td>Airport Planning and Design</td>
<td>3</td>
</tr>
<tr>
<td>CB 758</td>
<td>Highway Materials and Equipments</td>
<td>3</td>
</tr>
<tr>
<td>CB 759</td>
<td>Traffic Engineering and Environment</td>
<td>3</td>
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<tr>
<td>CB 750-T</td>
<td>Applied Finite Element Method to Vehicle-Ground Interaction Problems</td>
<td>3</td>
</tr>
<tr>
<td>CB 751-T</td>
<td>Highway Maintenance</td>
<td>3</td>
</tr>
<tr>
<td>CB 752-T</td>
<td>Advanced Construction Surveying</td>
<td>3</td>
</tr>
<tr>
<td>CB 753-T</td>
<td>Geographic Information Systems for Construction Engineering</td>
<td>3</td>
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<td><strong>Subtotal</strong></td>
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continued/…
M.Sc. in Construction and Building Engineering
Program Structure

(E) Transportation Engineering

.../continued

**ELECTIVE COURSES: GROUP (2)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CB 723</td>
<td>Environmental Impact Assessment of Civil Engineering Projects</td>
<td>3</td>
</tr>
<tr>
<td>CB 731</td>
<td>Advanced Geotechnical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CB 740-S</td>
<td>Finite Element Method</td>
<td>3</td>
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<tr>
<td>CB 745</td>
<td>Advanced Strength of Materials</td>
<td>3</td>
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<tr>
<td>CB 752-T</td>
<td>Advanced Construction Surveying</td>
<td>3</td>
</tr>
<tr>
<td>CB769</td>
<td>Structures for Integrated Water Resources Management</td>
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</table>

**Subtotal**

1 Course * 3 Credit Hours

3

**RESEARCH THESIS:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CB 701</td>
<td>Master's Research Thesis (Part 1)</td>
<td>6</td>
</tr>
<tr>
<td>CB 702</td>
<td>Master's Research Thesis (Part 2)</td>
<td>6</td>
</tr>
</tbody>
</table>

**Subtotal**

2 Parts * 6 Credit Hours

12

**Total**

36
Courses

DETAILED STRUCTURE
Course Code : CB 750
Course Title : Advanced Geometric Design
Credit Hours : 3

Course Description
The course covers advanced topics in the area of horizontal alignment which includes development of super-elevation with/without transition (spiral) curves, design values for spiral parameters. Also it covers vertical alignment which includes maximum and minimum gradient, critical length of grade, passing lanes, emergency escape lanes, vertical curves, crests and sags for SSD and PSD. It also covers cross section elements such as lane width and through, auxiliary, turning speed change, weaving, climbing, passing, parking, etc. In addition, the course covers advanced topics in the area of at-grade intersections and interchange intersections.

Course Objectives
To establish a solid background in advanced topics in the area of geometric design in highway engineering, railway engineering and to provide detailed design of all aspects of horizontal and vertical alignment.

Course Topics
- Horizontal Alignment
- Vertical Alignment
- Covers cross section elements
- Turning speed change, weaving, climbing, passing, parking, etc.
- Advanced topics in at-grade intersections and interchange intersections

References
Course Code : CB 751
Course Title : Fundamental of Traffic Flow Theories
Credit Hours : 3

Course Description
The course covers topics in the area of traffic flow characteristics, volume, flow, PHF, variation of traffic volume, AADT, ADT, DHV, speed-density model, flow-density model and speed-flow model. It also covers topics in the area of fundamental principles of traffic flow, level of service, basic freeway capacity, multilane highway capacity, two lane highway capacity, flow interruptions, intersection control and design, traffic signals, intersection capacity.

Course Objectives
To provide better understanding in the area of fundamental elements of traffic flow theories and traffic analysis tools for important highway segments as in two-lanes, multi-lanes and intersections.

Course Topics
- Traffic flow characteristics, volume, flow, PHF and variation of traffic volume
- AADT, ADT, DHV, speed-density model, flow-density model and speed-flow model
- Fundamental principles of traffic flow, level of services
- Basic freeway capacity
- Multilane highway capacity and two lane highway capacity
- Flow interruptions
- Intersection control and design
- Traffic signals
- Intersection capacity

References
Course Code : CB 752
Course Title : Structural Design for Highway and Airport Pavements
Credit Hours : 3

Course Description
The course covers topics in the area of pavement types, flexible and rigid pavement, principles for flexible pavements, calculation of flexible pavement stresses and deflections, the AASHTO flexible pavement design procedure, serviceability concept, structural number, principles for rigid pavements, calculation of rigid pavement stresses and deflection, the AASHTO rigid pavement design procedure, pavement rehabilitation management, the FAA method of design for flexible and rigid airport pavements, CBR method of design for flexible airport pavements, pavement design using elastic layer theory.

Course Objectives
To provide a complete analysis in the area of stress distribution in pavement due to different traffic loads, cover the major design methods for flexible pavements, and cover the major design methods for rigid pavements.

Course Topics
- Pavement types, flexible and rigid pavement
- Flexible pavement stresses and deflections
- The AASHTO flexible pavement design procedure
- Serviceability concept, structural number
- Principles for rigid pavements
- The AASHTO rigid pavement design procedure
- Pavement rehabilitation management
- The FAA method of design for flexible and rigid airport pavements
- CBR method of design for flexible airport pavements, pavement design using elastic layer theory

References
Course Code: CB 753
Course Title: Transportation Planning
Credit Hours: 3

Course Description
The course covers topics in the area of transportation planning (transportation problems, trends in transportation planning), urban transportation planning (elements of planning, planning process, goods movement planning), forecast of urban transport demand (data collection and analysis, goals and objectives, aggregate sequential demand models), sketch planning and project planning (generation, analysis and evaluation of alternative plans, risk and uncertainty).

Course Objectives
To provide basis of transportation planning and to grasp the sequential demand forecasting modeling.

Course Topics
- Transportation planning
- Urban transportation
- Forecast of urban transport demand
- Sketch planning and project planning

References
Course Code : CB 754
Course Title : Fundamentals of Railway Engineering
Credit Hours : 3

Course Description
The course covers topics in the area of railway track elements interaction (rail, wheel, interaction and force distribution), procedures to design the different components of railway track, geometric design of railway track, railway stations, classification, railway signaling, engineering principles of signaling and classification, modern methods of track maintenance, track maintenance rationalization, railway transpiration economics, advanced operating systems for railway.

Course Objectives
To provide a complete procedure for designing different components of railway track to cover important topics in railway engineering as in stations, signaling, etc.

Course Topics
- Railway track elements interaction
- Procedures to design the different components of railway track
- Geometric design of railway track, railway stations and railway signaling
- Engineering principles of signaling and classification
- Modern methods of track maintenance
- Track maintenance rationalization
- Railway transpiration economics
- Advanced operating systems for railway

References
Course Code : CB 755
Course Title : Off-the Road Vehicle Mobility
Credit Hours : 3

Course Description
The course covers topics in the area of off road traction mechanics, terrain material and interface reaction, mobility elements and requirements, elements of vehicle terrain interaction, floatation and traction, floatation and traction elements, rigid wheels, tiers, tier sizes and types, tier inflation pressure, tier traction, tracks, air cushion vehicle, mechanics of tractions, wheel-soft clay traction mechanism, wheel-mixed soil traction mechanism, wheel-snow traction mechanism, wheel-muskeg traction mechanism. The course also covers the factors affecting tier-ground surface traction coefficient, track-ground surface traction mechanism, track performance, prediction of tractive effort for tier and tracks.

Course Objectives
To provide a better understanding of vehicle traction mechanism and to give insight analysis to the tire-ground interface performance during mobility.

Course Topics
- Off road traction mechanics
- Elements of vehicle terrain interaction
- Floatation and traction
- Tier inflation pressure, tier traction and mechanics of tractions
- Factors affecting tier-ground surface traction coefficient
- Track-ground surface traction mechanism
- Track performance
- Prediction of tractive effort for tier and tracks

References
Course Code : CB 756  
Course Title : Special Topics in Transportation Engineering  
Credit Hours : 3

Course Description
The course covers topics in the area of transportation and the environment, transpiration safety, intelligent transportation systems, geographic information system application GIS, global positioning systems applications GPS, computer applications for transportation, computer simulators for transportation, energy efficiency and use, mass transit transportation, noise pollution fundamentals.

Course Objectives
To present different applications of computer technology in the field of transportation, such as GIS and GPS, Computer Modeling and Simulation.

Course Topics
- Transportation and the environment
- Transpiration safety
- Intelligent transportation systems
- Geographic information system application GIS
- Global positioning systems applications GPS
- Computer applications and simulators for transportation
- Energy efficiency and use, mass transit transportation
- Noise pollution fundamentals

References
- The U.S. Department of Transportation Internet Web Site (http://www.dot.gov/).
Course Code: CB 757
Course Title: Airport Planning and Design
Credit Hours: 3

Course Description
This course covers topics in the area of aircraft characteristics related to airport design, airport planning, airport configuration, runways, taxiways, holding aprons, relation of terminal area to runways, analysis of wind, obstructions in the vicinity of airport, airport capacity and delay, runway capacity through queuing theory, space-time concept, apron gale capacity, taxiway capacity, structural design of airport pavements, CBR method, FAA method, geometric design of runways, taxiways and taxi lanes.

Course Objectives
To cover complete procedures in airport planning and to provide design methods for different components of airport, such as runway, taxiway, etc.

Course Topics
- Aircraft characteristics related to airport design
- Airport planning
- Airport configuration, runways, taxiways, holding aprons
- Relation of terminal area to runways
- Analysis of wind, obstructions in the vicinity of airport, airport capacity and delay
- Runway capacity through queuing theory
- Space-time concept, apron gale capacity, taxiway capacity
- Structural design of airport pavements, CBR method, FAA method
- Geometric design of runways, taxiways and taxi lanes

References
- National Airport System plan, 1978-1987, Federal Aviation Administration, Department of Transportation, Washington DC.
- ICAO Journal, International Civil Aviation Organization, Montreal, Quebec, Canada [monthly].
Course Code : CB 758  
Course Title : Highway Materials and Equipments  
Credit Hours : 3

Course Description
The course covers topics in the area of aggregates (source - classification - properties - evaluation tests - combining of aggregates), bituminous materials (native asphalts - manufacture of asphalts - asphalt cement - liquid asphalt - emulsions), asphalt tests (liquid asphalt test, emulsion tests), highway machinery (earth moving, compaction, aggregates crushing), asphalt machinery (plants, spreaders,...).

Course Objectives
To review material properties, testing in association with highway construction, different methods of construction and involved equipments.

Course Topics
- Aggregates (source - classification - properties - evaluation tests - combining of aggregates)
- Bituminous materials
- Asphalt tests (liquid asphalt test, emulsion tests)
- Highway machinery (earth moving, compaction, aggregates crushing)
- Asphalt machinery (plants, spreaders,...)

References
- Standard Specifications for Transportation Materials and Method of Sampling and Testing, AASHTO, Washington DC.
Course Code: CB 759
Course Title: Traffic Engineering and Environment
Credit Hours: 3

Course Description
This course covers topics in the area of basic principles of sound waves in free fields and enclosures, effect of noise on people, adding and subtracting sound levels, traffic noise descriptors, traffic noise prediction techniques, prediction procedure, mathematical algorithm, correction for road gradient, source height, source position, mitigation measures, sound barriers, pavement types, principles of sound barrier design, reduction in sound barrier performance due to holes, silts or gaps, examples of sound barrier analysis.

Course Objectives
To review basis of traffic noise, to provide traffic noise prediction techniques, and to provide noise barrier design methods.

Course Topics
- Basic principles of sound waves in free fields and enclosures
- Effect of noise on people, adding and subtracting sound levels
- Traffic noise descriptors, traffic noise prediction techniques
- Mathematical algorithm
- Correction for road gradient, source height, source position, mitigation measures
- Sound barriers, pavement types, principles of sound barrier design
- Silts or gaps
- Examples of sound barrier analysis

References
Course Code : CB 750-T
Course Title : Applied Finite Element Method to Vehicle-Ground Interaction Problems
Credit Hours : 3

Course Description
The course covers topics in the area of finite element modeling for vehicle-ground interaction problems, analytical relationships, problem idealization, idealization of discontinuities, joint element stiffness formulation, soil cutting idealization tire-soil idealization, constitutive relationships, boundary conditions, material and geometric nonlinearity, meshes and boundaries, measures and calculated forces, deformation fields, stress analysis, contact pressure distribution, tangential pressure distribution, prediction of vehicle performance.

Course Objectives
To show different modeling techniques for the general tire-ground interaction problems and to present the FEM as a useful tool to analyze / predict tire-ground performance

Course Topics
- Finite element modeling for vehicle-ground interaction problems
- Analytical relationships, problem idealization
- Joint element stiffness formulation
- Soil cutting idealization tire-soil idealization
- Constitutive relationships, boundary conditions
- Material and geometric nonlinearity
- Deformation fields
- Stress analysis, contact pressure distribution
- Tangential pressure distribution

References
Course Code : CB 751-T
Course Title : Highway Maintenance
Credit Hours : 3

Course Description
Maintenance of asphaltic highways (failure of flexible pavement - pavement distress - maintenance methods), maintenance of concrete highways (failure of rigid pavement - maintenance of cracks and joints-strengthening of pavement), maintenance of earth roads (earth problems- maintenance of earth roads), methods of measuring effects.

Course Objectives
To familiarize the student with different types of road failure for both flexible and rigid pavements, to provide the student with major maintenance methods for both flexible and rigid pavements.

Course Topics
- Maintenance of asphaltic highways (failure of flexible pavement - pavement distress - maintenance methods)
- Maintenance of concrete highways (failure of rigid pavement - maintenance of cracks and joints-strengthening of pavement)
- Maintenance of earth roads (earth problems- maintenance of earth roads), methods of measuring effects

References
Course Code : CB 752-T
Course Title : Advanced Construction Surveying
Credit Hours : 3

Course Description
The different types of projects traverses, the purpose and types of cadastral surveying traverses in cities and countries, the field traverse and its procedure, the public work traverse and methods of fixing boundary marks, the city traverse and its requirements, the three points problem and the mechanical, legman and three circles methods, cadastral and town mapping. Adjustment of structure verticality, study of crustal movement and geodetic techniques for detecting horizontal and vertical structural deformations. Laser instruments and techniques in various surveying applications such as leveling, land reclamation, etc. Precise methods for measuring horizontal angles.

Course Objectives
To provide the graduate with most advanced equipments in the field of construction surveying. In addition to, different methods of analysis and correction of coordinate systems.

Course Topics
- Projects traverses
- The three points problem and the mechanical
- Legman and three circles methods
- Cadastral and town mapping
- Adjustment of structure verticality
- Study of crustal movement and geodetic techniques for detecting horizontal and vertical structural deformations
- Laser instruments and techniques in various surveying applications such as leveling, land reclamation, etc.
- Precise methods for measuring horizontal angles

References
Course Code: CB 753-T
Course Title: Geographic Information Systems for Construction Engineering
Credit Hours: 3

Course Description

Course Objectives
To introduce and illustrate how the Geographic Information System (GIS) can be build up to analyze and understand various problems in construction engineering.

Course Topics
- Basics and components of GIS
- Types of data entry and tools
- Sequence of building GIS system
- Analytical functions and how to use them
- General applications for construction engineering
- GIS for transportation engineering
- GIS for highway engineering
- GIS for geotechnical engineering
- GIS for environmental engineering

References