POST GRADUATE PROGRAMME

Master of Technology
(M. Tech.)

IN

TRANSPORTATION ENGINEERING & PLANNING

DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR
HAZRATBAL, SRINAGAR, KASHMIR, J&K, INDIA - 190006
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Importance of Transportation Engineering

Transportation is one of the most important disciplines in the broad field of Civil Engineering; very much a part of its history and heritage. The traditional field of transportation, focusing primarily on roads, now includes the study, design, and operation of large and highly complex systems of transportation networks comprising all modes. As the field of Civil Engineering has matured and made increasing use of advanced technologies (including modeling, simulation, new materials, sensors and real-time monitoring/control), transportation engineers have seen increased opportunities and been able to address new challenges. Transportation research in the areas of materials, traffic, safety, control devices, transportation economics, policy, network analysis and the design of transportation infrastructure will go a long way in providing the nation with solutions to challenges, encountered in the course of providing requisite quality infrastructure. A well planned and sophisticated transportation system is a basic need for development of any Nation. The success story of a nation can largely be accredited to its infrastructural progress. The economic boom in India has, on the one hand, tremendously increased the need of infrastructure development in the country and on the other hand, created options for availability of financial resources for investment in such developments. To sustain the current economic growth and give it a further boost it is becoming critically important to give a fillip to the development of infrastructure like ports, roads and bridges, highways, railways and airports. An infrastructural growth rate of at least 15 percent is crucial for the national GDP to grow at 10 percent over the next five years. The government of India aims to spend billions of dollars to develop world class infrastructure and has undertaken various mega transportation projects like Prime Minister’s Gram Sadak Yojana (PMGSY) and National Highway Development Project (NHDP).

Necessity of Post Graduate Programme

The rapid development of infrastructure needs more and more expert technical manpower. Challenges like heavy traffic congestion on the roads, urban sprawl, landing and take-off delays at airports, accessibility through hazardous terrains, providing smart vehicle parking, traffic safety, planning of pedestrian and bicycle facilities, optimizing operation and economy, pavement durability and construction methodologies in adverse terrain and weather conditions, and environment impact need customized solutions by well trained transportation professionals and through cutting edge research. At local level establishing proper accessibility and providing good quality pavements still remain the areas of high priority. Realizing this aspect the Civil Engineering Department of NIT Srinagar proposes to start a four-semester Post Graduate Programme (Master of Technology) in ‘Transportation Engineering & Planning’ which is envisaged to evolve as a programme for higher learning and research in the field of Transportation Engineering and Planning.
Main Objectives

The main objectives of the programme are, (i) To promote higher learning and research in the field of Transportation Engineering, (ii) To offer consultancy services in the areas related to Transportation Engineering, (iii) To undertake sponsored research projects as a part of research and development activities in the emerging areas of technology and (iv) to provide a forum for exchange and upgradation of knowledge in the field of Transportation Engineering through seminars, conferences, workshops, training courses etc.

Focus Areas

The department, with its varied faculty expertise can offer courses and conduct research in diverse areas of Transportation Engineering and Planning. The programme aims to focus on areas like, (i) Planning, Analysis, Design and Evaluation of Multi-modal Transportation Systems, (ii) Management, Operation and Safety of Traffic, (iii) Intelligent Transportation Systems, (iv) Modeling and Simulation of Traffic and Transportation Processes and (v) Planning, Design and Maintenance of Transportation Infrastructure.
DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR, J&K - 190006

SCHEME FOR
M.TECH. IN TRANSPORTATION ENGINEERING & PLANNING
Applicable for Batch 2016 Onwards

**SEMESTER – I**

<table>
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<tr>
<th>Sr. No.</th>
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<td>Traffic Laboratory/Field studies</td>
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<td>Computer Applications</td>
<td>3</td>
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<td>Engineering Behavior of Soils</td>
<td>3</td>
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<td>Rail and Air Transport Engineering</td>
<td>3</td>
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<td>Advanced Concrete Technology</td>
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<td>Transportation Facility Design</td>
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<td>Construction Techniques and Management</td>
<td>3</td>
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<td>CTE-112-E2</td>
<td>Environmental Impact Assessment and Management</td>
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L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work
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<td>Pavement Analysis &amp; Design</td>
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<td>Transportation Planning – II</td>
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<td>Highway Materials Laboratory</td>
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<td>Ground Improvement Techniques</td>
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<td>Road Safety &amp; Environment</td>
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<td>Decision Models in Management</td>
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<td>Urban Planning Techniques &amp; Practice</td>
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L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work
### SEMESTER – III

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<td>CWE-302-E1 Hydraulic Structures</td>
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L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work  
* Field studies and Studio work.

### SEMESTER – IV

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**Grand Total of Credits = 60**

**Evaluation:**

- Attendance & Class performance : 10%
- Minor Tests (1 & 2) : (20% + 20%) =40%
- Major Test (1) : 50%
NOTE:
1. Each Elective Group contains at least one subject of inter-department or of other P.G. areas of the department in order to make the system more flexible and to meet the options of P.G. students of their interest area.
2. Examination of Practicals/Tutorials will be conducted by two internal examiners.
3. One external examiner & concerned internal examiners shall be conducting viva-voce examination in case of Dissertation at Semester IV.
4. Evaluation and examination system for seminar and dissertation will be at par with other P.G. programs of the department.
5. The dissertation involves a detailed study of a Transportation related, problem (actual field/research) which a student has to carry out under the supervision of one of the faculty members of the Department. The dissertation work can also be of interdisciplinary nature with transportation element involved.
6. Part-time students will be eligible to take up the 3rd semester regular in their 5th semester, only when they have successfully completed the 1st and 2nd semesters.
MTHM-101 APPLIED STATISTICS

Social Research Formulation: Design of research, scaling techniques, sampling techniques, design of questionnaire.

Statistics & Probability Base: Various probability distributions & their applications, parameter estimation, hypothesis testing, random variables, method of maximum likelihood, hypothesis testing to compare multiple population, statistical quality control.

Linear & Multi-linear 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, multiple regression models.

Optimisation techniques: Linear programming, Simplex method, transportation model, concepts of non – linear programming, decision theories-rules, decision under uncertainty.

References:
CTE 102 TRANSPORTATION PLANNING - I

SEMESTER: IST L T P C
COURSE NO. CTE-102 3 1 0 3

Transportation Planning Process & Surveys: Urbanisation process & urban land use structure, transportation problems in Indian context, transportation study area, zoning & surveys, transportation planning process- inventory, model building, forecasting and evaluation stages, planning in system engineering framework.

Travel Demand Estimation: Assumptions in demand estimation- sequential, recursive and simultaneous process. basic planning stages-trip generation, trip distribution, modal split and route assignment, various techniques of demand estimation and analysis.

Landuse-Transportation Models: Location models - opportunity models, accessibility models, lowry based land use- transportation models in practice

References:

CTE 103 TRAFFIC ENGINEERING

SEMESTER: IST L T P C
COURSE NO. CTE-103 3 1 0 3

Traffic Engineering & Studies: Scope, traffic elements, characteristics-vehicle, road user and road; traffic studies-speed & delay, traffic volume, O & D, parking and accidents, sample size, study methodology, data collection & presentation,

Traffic Analysis: Speed, volume, parking & accident data analysis, statistical approach, traffic maneuvers, different intersections, conflict points, traffic stream characteristics- relationship between speed, flow and density, level of service & capacity analysis, traffic forecasting.

Traffic Design: Channelisation of islands for different traffic situations, design of rotaries & at-grade intersections, grade separated intersections, their warrants; facilities for pedestrian & bicycle ways, bus stop location and bus bay design, transport terminals, parking parcels, design of road lighting at different road sections & intersections.

Traffic Control Devices: Traffic signs, markings and signals; principles of signal design, Webster's method, signal coordination.

Traffic Regulation & Management: Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, management techniques-one-way, tidal flow, turning restrictions etc., road safety measures
References:
3. O’Flaherty C A, Highways- Traffic Planning & Engineering, Edward Arnold, UK
7. IRC-SP 41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas
8. Other relevant IRC codes.

CTE 104 TRAFFIC LABORATORY/FIELD STUDIES

SEMESTER: IST L T P C
COURSE NO. CTE-104 0 0 3 1

Field Study/lab work: Study of Road user characteristics in lab; study of traffic speed & delay, traffic volume, O & D, parking and accidents in field.

Data collection, analysis and presentation.

CTE-105–E1 COMPUTER APPLICATIONS

SEMESTER: IST L T P C
COURSE NO. CTE-105-E1 3 1 - 3


C++ Programming Basics: Using Turbo C++, Basic program construction, preprocessor directive, #include, #define, Header and Library functions, Keywords, INPUT-OUTPUT Statements, comments, Constants, Variables, and operators, Formatting statements, ENDL and SETW manipulators.

Loops, Decision and Arrays: WHILE, DO-WHILE and FOR loops, general structure and control. IF, IF-ELSE statements, SWITCH, BREAK, CONTINUE statements, GOTO and labels, ARRAY fundamentals, types, use and manipulation of 2-D arrays as Matrices.

Functions: Concept of modularization of structured programming. Basics of functions, their types declaration, definition and structure.

Object Oriented Programming Concept: General concepts of Object Oriented Programming, Objects and Classes, Member Functions, user defined data, Pointers, etc.

File Processing: Streams, String I/O, Character I/O, Object I/O, input-output with Multiple objects, File Pointers, Disk I/O with Member Functions, Error Handling, Printer Output.
Practical Applications: Programming for mathematical models of Civil Engineering problems and Management information systems, use of general purpose programmes.

References:
1. Object Oriented Programming with C++ by Robert Lafore

CTE-106-E1 ENGINEERING BEHAVIOR OF SOILS

SEMMESTER: 1ST
COURSE NO. CTE-106-E1 3 1 0 3


References:
Partial List
Soil Mechanics - T.W. Lambe and R.V. Whitman
Soil Engineering - M.G.Sprangler
Foundation Engineering - G.Leonards
Principles of Soil Mechanics - R.F.Scott

CTE-107-E1 RAIL AND AIR TRANSPORT ENGINEERING

SEMMESTER: 1ST
COURSE NO. CTE-107-E1 3 1 0 3

Rail Transportation System: Railway Track system & sub-structures, Railway infrastructure, Modernisation in track, safety in railways, under-ground railways, Demand analysis and forecasting for passenger and freight traffic costing and pricing principles, project analysis and design; project interdependencies and programming techniques; systems analysis and systems planning; macroeconomic transportation simulator; case studies and implementation strategies.

Characteristics of Air Transportation, structure and organization, challenges and the issues, Airport Master Plan, Characteristics of the aircraft, Airport Requirements, site selection, layout plan and financial plan, Forecasting air travel demand, Air freight demand

Geometric Design of runway, taxiway, aprons, Design of Passenger Terminal, analysis of flow through terminals, Design of air cargo facilities, Airfield pavement and drainage design,
Environment impact of Airports. Air traffic control lighting and signing, Airport capacity and configuration, parking configurations and apron facilities

References:

CSE-103-E2 ADVANCED CONCRETE TECHNOLOGY

SEMMESTER: IST       L    T    P    C
COURSE NO. CSE-103-E2  3    1    0    3

Concrete Making Materials: Aggregates – Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates.

Cement: Chemical composition, Hydration of cement, structure of hydrated cement, special cements, water chemical admixtures.


Mix Design: Principles of concrete mix design, Methods of concrete mix design, Testing of concrete.

Special Concretes: Light weight concrete, Fibre reinforced concrete, Polymer concrete, Super plasticized concrete, Properties and applications.


References:
CTE-110-E2 TRANSPORTATION FACILITY DESIGN

SEMESTER: IST  L  T  P  C
COURSE NO. CTE-110-E2  3  1  -  3

Introduction: Design of highways, design of at-grade intersections, design of signalized intersection, design of grade separated intersection, terminal design, and design of facilities for non-motorised transport.

Terminal Planning & Design: Terminal functions, analysis of terminals, process flow charts of passenger & goods terminals, terminal processing time, waiting time, capacity & level of service concept, study of typical facilities of highway, transit, airport and waterway terminals, concept of inland port.

Design of Highways: Hierarchy of highway system, functions, design designations, concepts in horizontal & vertical alignment, integration, optical design, geometrical standards for mobility & accessibility components, landscaping and safety considerations, evaluation and design of existing geometrics.

Design of Intersections: Review of design of at-grade intersections, signal coordination – graphic methods & computer techniques, grade separated intersections – warrants for selection, different types & geometric standards, spacing & space controls, ramps & gore area design.

References:
2. IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas

CTE-111-E2 CONSTRUCTION TECHNIQUES AND MANAGEMENT

SEMESTER: IST  L  T  P  C
COURSE NO. CTE-111-E2  3  1  0  3

Construction planning-Construction facilities, Schedules, Layout of Plant utilities, Construction methods: Excavation and handling of Earth and Rock; Production and handling of Aggregates and Concrete, cooling of concrete in dams, Drainage treatment of aquifers/sub-terrainean reservoirs; Tunneling, Tunneling in soft rocks- Grouting, chimney formation, etc.; Construction control and management-CPM/PERT, Human Factors, Organisation.

References:
Introduction: Concepts of environmental impact analysis, key features of National environmental policy act and its implementation, screening in the EIA process, utility and scope of EIA process, Environmental protection acts EIA at national level. Conceptual approach for environmental impact studies, planning and management of impact studies, matrix and network methodologies for impact identification, description of the affected environmental – environmental indices.

Prediction and Assessment of Impact on Air Environment: Basic information on air quality, sources of air pollutants, effects of air pollutants, key legislations and regulations, conceptual approach for addressing air environment impacts, impact prediction approaches, assessment of significance of impacts, identification and incorporation of mitigation measures.

Prediction & Assessment of Impact on Noise & Social Environment: Basic information on noise, key legislation and guidelines, conceptual approach for addressing noise environment impacts, impact prediction methods, assessment of significance of impacts, identification and incorporation of mitigation measures, Conceptual approach for addressing socio-economic impacts, traffic and transportation system impacts, visual impacts, scoring methodologies for visual impact analysis


References:
6. Relevant IRC & CPCB codes.
CTE-201  PAVEMENT ANALYSIS AND DESIGN

SEMESTER: 2ND  L   T   P   C
COURSE NO. CTE-201  3   1   -   3

Pavement Mix Analysis: Aggregate blending, bituminous mix design – Marshall stability approach, concrete mix design for roads.

Pavement Basics: Types & comparison, vehicular loading pattern, loading pattern on airport pavement, factors affecting design and performance of pavements, airport pavement, environmental impact on pavements, sub grade requirements

Design of Flexible Pavements: Analytical approach, flexible pavement layers, ESWL, repetitions of load, techniques of design methods, wheel load analysis, traffic analysis, stress distribution in subgrade soil, Burmister's theories, group index method, CBR approach, IRC guidelines, CRV method, triaxial & McLeod method, present practices, shoulder design.

Design of Concrete Pavements: Westergaard’s approach, temperature & frictional stresses, design of expansion & longitudinal joints, design of dowel & tie bars, IRC guidelines, present design practices.

References:
5. IRC: 37, Guidelines for the Design of Flexible Pavements (Second Revision).

CTE-202  TRANSPORTATION PLANNING – II

SEMESTER: 2ND  L   T   P   C
COURSE NO. CTE-202  3   1   -   3

Demographic and Employment Forecasting Models: Demographic models - linear, exponential and logistic models; cohort survival models - birth, aging and migration models; employment forecasting models - economic base mechanism; input and output models - dynamic models of population and employment, multiregional extensions

Transport Modelling: Need & role of transport models, issues, transport models in practice, simplified transport demand models
Regional Transportation Development - Delineation of Planning Regions: Concept of region and space – types of regions, rural road network development approach, regional freight transportation-issues & approach, demand assessment, various models.

Urban Mass Transit Planning & Modelling: Transit classification, transit network design, classification of routes, prediction of transit usage, evaluation of network, scheduling principles & methodology, urban freight transportation: freight demand, spatial distribution of goods, truck terminal planning,

References:

CTE-203  HIGHWAY MATERIALS LABORATORY

SEMESTER: 2ND  L  T  P  C
COURSE NO.  CTE-203  0  0  3  1

Laboratory Testing of highway materials- sub grade soil, coarse and fine aggregates, bituminous binders, bituminous mixes, cement and cement concrete

CGE-201  GROUND IMPROVEMENT TECHNIQUES

SEMESTER: 2ND  L  T  P  C
COURSE NO.  CGE-201  0  3  1  3

Site investigation and subsoil exploration; Need for soil stabilization, Principles of soil stabilization; Methods of soil stabilization- Mechanical, lime, cement, bitumen, special chemicals and other waste materials, Mechanisms of soil stabilization, Dynamic compaction; Preloading; Vertical drains; Granular piles; Grouting; Soil nailing; Anchors; Vacuum consolidation; Thermal, electrical and chemical methods; Soil Reinforcement; Case histories.

References:
Partial List
Highway Geometrics: Importance, highway system elements-road user and vehicular characteristics, mix traffic characteristics, classification of rural & urban roads, neighbourhood roads, roads in residential areas, geometric design factors-design speed, topography, traffic & environmental factors.

Cross-sectional Elements: Road surface characteristics- evenness, friction & skidding, camber values & implementation, lane width criteria for different modes, kerb, median, road margins, cross-sectional details for different categories of roads.

Sight distances: Sight distance factors & types, overtaking zones, grade impact, sight distances on head-light criteria.

Alignment: Alignment issues, factors, horizontal alignment, super-elevation design and implementation, pavement widening, transition curves, setting up of transition curves by surveying equipments, set back distances, vertical alignment, types of gradients and vertical curves, design of vertical curves & implementation.

Intersection Geometrics: Types of intersections, blind intersections, sight distances, island geometrics, geometrics for merging & diverging, geometrics for bus stop layouts, parking areas & fly-overs, rail-road level crossing.

References:

Multidisciplinary approach to planning for traffic safety and injury control; pre crash and post crash models; Roles of vehicle , roadway traffic, driver, and environment, crash and injury causations; Accident analysis, Conflict points at intersections, Pedestrian safety,

Road safety Audit: Mixed traffic flow; Transport related pollution; Technology Vision-2020;Urban and non urban traffic noise sources, Noise pollution;

Energy related aspects of different transport technologies. Traffic calming Measures. Road transport related air pollution, sources of air pollution, effects of weather conditions, Vehicular emission parameters, pollution standards, measurement and analysis of vehicular emission; Imitative measures;
EIA requirements of Highways projects, Procedure; MOEF World Bank/RC/UK guidelines; EIA practices in India.

References:
1. Evans S.K., Traffic Engineering Handbook, Institute of Traffic Engineers, USA
6. Relevant IRC codes

CTE-208-E1 DECISION MODELS IN MANAGEMENT

SEMESTER: 2ND L T P C
COURSE NO. CTE-208-E1 3 1 0 3


Linear Programming: Advanced Methods- Heuristics, Simplex method, duality, post- optimality analysis, non linear programming, Sensitivity analysis, Unconstrained and constrained optimization, Kuhn- Tucker theory; Quadratic programming applications.

Transportation LP problems: Assignment problems, Queuing theory, Queuing Models, Markov decision processes; Applications to inventory management and Replacement processes.


Integer programming, goal programming, dynamic programming. Decision theory. Role of knowledge; Deterministic and probabilistic situation, Single and multiple person decision making.

References:
1. N.D.Vora. Quantititative techniques in management, S.Chand Publications
Principles of GIS, GPS and Remote Sensing: Basic concepts of GIS & GPS, introduction to remote sensing, remote sensing system, electromagnetic spectrum, black body, atmospheric windows, spectral characteristics of earth’s surface, range of sensing system.

GPS: Basic concepts, components, factors affecting, GPS setup, accessories, segments- satellites & receivers, GPS applications, Case studies

Platforms, Sensors and Data Products: Ground aircraft, Spacecraft platforms, photographic sensors, scanners, radiometers, radar and mission planning, data types and format, scale and legend.

Interpretation and Analysis Techniques: Multispectral, multitemporal, multisensoral, multistage concepts, photo interpretation techniques for aerial photo and satellite imagery, interpretation elements, false colour composition, etc.

Photogrammetry: Photogrammetry- Basic application, applications of aerial photo interpretation to water resources engineering.

Digital Analysis: Preprocessing and processing, image restoration/enhancement procedures, pattern recognition concepts, classification algorithms, post processing procedures.

Structure of GIS: Cartography, Geographic mapping process, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, database management systems, Raster data representation, Vector data representation, Assessment of data quality, Managing data errors, Geographic data standards.


Application in Civil Engineering: River drainage and flood flow, watershed delineation and characteristic studies, command area mapping, drought assessment, groundwater inventory, soil moisture study, water quality assessment and monitoring, Land use data acquisition, disaster management.

References:

CWE-213-E1 GIS & REMOTE SENSING APPLICATIONS IN CIVIL ENGINEERING

SEMESTER: 2ND  L  T  P  C
COURSE NO. CWE-213-E1  3  1  0  3

**CWE-203-E2 GROUND WATER HYDROLOGY**

**SEMESTER: 2ND**
**COURSE NO. CWE-203-E2**

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Occurrence of ground water types of aquifers, ground water in different formations, aquifer properties.

Ground water movement: Basic equations of steady and unsteady groundwater flow in confined and unconfined aquifers.

Well Hydraulics: mechanics of well flow into fully and partially penetrating wells in confined aquifers, leaky aquifers, unconfined aquifers, approximate solutions, multiple well systems, aquifer tests, well design criteria, ground water control.

Techniques of artificial recharge, solution to transit problems of ground water mounds, theory of subsurface drainage, stream aquifer systems, ground water quality, Sea water intrusion into coastal aquifers, digital and analogue models for evaluation of aquifer response.

**References:**
4. E. Custodio(Editor); Study and Modelling of Salt water Intrusion into Aquifers, CIMNE publications, Barcelona, Spain.
7. R. Willis and W.W.G. Yeh; Groundwater Systems Planning and Management, Prentice Hall New Jersey.
CTE-209-E2  SOFT COMPUTING TECHNIQUES

SEMESTER: 2ND  L  T  P  C
COURSE NO. CTE-209-E2  3  1  0  3


References:
2. Simon Haykin, Neural Networks, PrenticeHall

CTE-210-E2  TRAFFIC FLOW THEORIES

SEMESTER: 2ND  L  T  P  C
COURSE NO. CTE-210-E2  3  1  0  3


Queuing Analysis: Fundamentals of Queuing Theory, Demand Service Characteristics, Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Models of Delay at Intersections and Pedestrian Crossings.


References:
1. TRB - SR No.165 - Traffic Flow Theory, Transportation Research Board, Washington - D.C.
4. TRB Special Report 209: Highway Capacity Manual, Transportation Research Board,

CTE-211-E2 URBAN PLANNING TECHNIQUES AND PRACTICE

SEMESTER: 2ND
COURSE NO. CTE-211-E2

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Land use Activities: Analysis and prediction of important land use activities like population, employment, housing, shopping, leisure, transport.


Techniques of Preparation of Base Maps: Drawing size, scale, format, orientation, reduction and enlargement of base maps.


Urban Renewal: Meaning, significance, scope and limitations, urban renewal as a part of metropolitan plan, the process of urban renewal, identification of renewal areas, renewal policies and strategies and management of renewal areas, central areas and their renewal.

Concept of New Towns: Meaning, role and functions: Special planning and development considerations, scope and limitations of new town development, Indian and British experience of planning and development of new towns.


References:
1. Margaret Roberts, Town Planning Techniques, Hutchinson Educational Publication.
4. Ramegauda K.S., Urban and Regional Planning, Mysore University Publication.
CTE-301   TRANSPORTATION ECONOMICS & EVALUATION

SEMESTER: 3RD   L  T  P  C
COURSE NO. CTE-301  3  1  0  3

Principles of Economics: Supply and demand models, consumer's surplus and social surplus criteria, framework for social accounting: accounting rate of interest, social opportunity cost, rate of interest, social time preference rate of interest, accounting prices of goods and services, measuring input costs, applications of social accounting framework.

Transport Costs and Benefits: Fixed and variable cost, cost of improvement, maintenance cost, cost estimating methods, accounting for inflation, external costs, pavement cost analysis. Direct benefits-reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost.

Economic Analysis: Generation and screening of project alternatives, different methods of economic analysis: annual cost and benefit ratio methods, discounted cash flow methods, shadow pricing techniques, determination of IRR and NPV, examples of economic analysis, application economic theory in traffic assignment problem.

References:
2. Kenneth J. Button, Transport Economics, Elgar
4. Emile Quinet, Roger Vickerman, Principles Of Transport Economics, Edward Elgar Pub
5. Road User Cost Study, Central Road Research Institute

CSE-301-E1   ADVANCED BRIDGE ENGINEERING

SEMESTER: 3RD   L  T  P  C
COURSE NO. CSE-301-E1  3  1  0  3

History of Bridge Development: Classification of bridges, Selection of bridge sites, Bridge alignment, Sub-surface investigations, Bridge Hydrology, Flood discharge, waterways, scour depth, depth of foundation, standards of loadings, types of loads, impact effect, wind loads, seismic forces, buoyancy, earth pressure, loadings on various bridges, traffic requirements, types of low cost bridges, Settlements, Allowable soil pressures, types of foundations, foundation failures, foundation setting, cofferdams

Bridge Superstructure: Superstructure elements, Bridge flooring, design of slab bridges & girder bridges, Bridge bearings, joins in bridges, bridge superstructures, piers, abutments, wingwalls and approaches,
Bridge construction: Erection of steel girder bridges, truss bridges, suspension bridges, maintenance of bridges, bridge testing for safe carrying capacity, Strengthening of bridges, aesthetical treatments.

References:
1. Bindra S.P., Bridge Engineering, Dhanpat Rai & Sons
2. Relevant IRC codes,
3. MoRTH Specification for Roads & Bridges

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**CWE -302-E1  HYDRAULIC STRUCTURES**

**SEMMESTER: 3RD**

**COURSE NO. CWE -302-E1**

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Highway Drainage: Importance, principles of surface drainage, roadside drains- cross-section; design, drains for hill roads, subsurface drains, capillary cut-off treatment.
Cross Drainage Works: Importance of cross drainage, causeways, culverts & bridges- types; estimation of design discharge, fixation of waterway, foundation depth and spans.

References:
4. L. R. Kadiyali and N. B. Lal; Principles and Practices of Highway Engineering, Khanna Publishers Delhi, 2005

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**CTE-304-E1  PAVEMENT MANAGEMENT SYSTEM**

**SEMMESTER: 3RD**

**COURSE NO. CTE-304-E1**

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Pavement Maintenance & Management Process: Application of system concepts to pavement management, pavement management levels-Network & Project level, functions - Data needs, Pavement life cycle, assessment of pavement performance, evaluation of pavement structural capacity, distress & safety, combined measures of pavement quality, data management

Determining Present and Future Needs: Establishing criteria – development of models for pavement deterioration – determining the future needs – rehabilitation and maintenance strategies – developing combined programmes for maintenance & rehabilitation
Project Level Design: Framework for pavement design, characterization of physical design inputs, basic structural response models – variability, reliability and risk – generating alternate design strategies, rehabilitation design procedures, Overlay design, economic evaluation of alternate pavement design strategies – selection of optimal design strategy.

Implementation: Major steps in implementing PMS – pavement construction management & pavement maintenance management – information’s, research needs – cost and benefit of pavement management – future directions and need for innovations in pavement management, HDM applications.

References:

CTE-305-E1 PROJECT APPRAISALS & DEVELOPMENT MANAGEMENT

SEMESTER: 3RD L T P C
COURSE NO. CTE-305-E1 3 1 0 3

Philosophy of project, Project goals, Project Formulation, Life Cycle Analysis, Feasibility and Impact Analysis, Effectiveness Analysis, Multi Criteria Evaluation Methods, Analytical Hierarchal Method, Decision Making Under Risk


References:
CTE-306 SEMINAR

SEMESTER: 3RD
COURSE NO. CTE-306

Each student is required to prepare and submit a seminar paper in consultation with Dissertation Supervisor. And seminar is to be presented on scheduled date decided by the P.G. Centre.

CTE-307 DISSERTATION PRELIMINARIES

SEMESTER: 3RD
COURSE NO. CTE-307

Dissertation preliminaries should clearly identify the goals & objectives and scope of the dissertation work taken up by the candidate. The focus is on data identification and proposed field surveys, questionnaire design, sample size decision. The study methodology and literature review on the dissertation topic is to be completed and a typed report is to be finalized in consultation with dissertation supervisor and submitted for the assessment at the end of the semester.

4TH SEMESTER

CTE-401 DISSERTATION

SEMESTER: 4TH
COURSE NO. CTE-401

1. The preliminary dissertation work initiated in Third semester is further extended over fourth semester to cover up the field studies, data analysis, modeling, if any and research finding followed by conclusion etc.

2. The main objective of the dissertation work is to provide scope for original & independent research to express the ability of using analytical approach or technical investigation.

3. Thesis is to be prepared by each student under the guidance of faculty supervisor and finally submitted in six typed bound sets as per the specified time.

4. The assessment of the dissertation work will be carried out in two stages, first during the semester for 100 marks, followed by final viva-voce exam for 200 marks at the end of the semester.