POST GRADUATE PROGRAMME

Master of Technology
(M. Tech.)

IN

TRANSPORTATION ENGINEERING & PLANNING

Approved by

Board of Studies (BOS)

&

P. G. Review Committee

&

SENATE

Submitted by

DEPARTMENT OF CIVIL ENGINEERING
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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 Pogramme (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 Objective and Focus Areas

The main objective of the programme is to promote higher learning and research in the field of Transportation Engineering 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.

Scheme and Course Structure

Name of the Course: M. Tech in Transportation Engineering and Planning

Qualification / Eligibility Requirements:

- B.Tech./B.E. (Civil Engineering / Infrastructure Engineering / Highway Engineering / Traffic Engineering)
- **Other requirements for M.Tech. Programme:** As per MHRD/NIT Srinagar norms.

Intake: **Proposed Annual Intake (General + OBC/SC/ST etc + Sponsored) = 18 Students = [(10+3+5) Students]**

The proposed scheme and course structure for the Post Graduate Programme is attached. The detailed syllabus for the specified courses is also presented.

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR, J&K - 190006

SCHEME FOR
M.TECH. IN TRANSPORTATION ENGINEERING & PLANNING
Applicable for Batch 2019 Onwards

SEMESTER – I

Sr. No.	Subjects	L	T	P	Credit
Core Courses					
MTHM-101	Applied Statistics	3	1	-	3
CTE-102	Transportation Planning – I	3	1	-	3
CTE-103	Traffic Engineering	3	1	-	3
CTE-104	Traffic Laboratory/Field studies	-	-	3	1
Elective I (any one)					
CGE-101-E1	Engineering Behavior of Soils	3	1	-	3
CTE-105-E1	Computer Applications	3	1	-	3
CTE-107-E1	Rail and Air Transport Engineering	3	1		3
CTE-108-E1	Public Transport Planning	3	1	-	3
Elective II (any one)					
CSE-103-E2	Advanced Concrete Technology	3	1	-	3
CTE-110-E2	Transportation Facility Design	3	1	-	3
CSE-106-E2	Construction Technology and Management	3	1	-	3
CTE-112-E2	Environmental Impact Assessment and Management	3	1	-	3
				Total	16

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work

SEMESTER – II

Sr. No.	Subjects	L	T	P	Credit
Core Courses					
CTE-201	Pavement Analysis & Design	3	1	-	3
CTE-202	Transportation Planning – II	3	1	-	3
CTE-203	Highway Materials Laboratory	-	-	3	1
CTE-204	Traffic Flow Theories	3	1	-	3
Elective I (any one)					
CTE-206-E1	Geometric Design of Highways and Streets	3	1	-	3
CTE-207-E1	Road Safety & Environment	3	1	-	3
CTE-208-E1	Decision Models in Management	3	1	-	3
CWE-213-E1	GIS & Remote Sensing Applications in Civil Engineering	3	1	-	3
Elective II (any one)					
CGE-201-E2	Ground Improvement Techniques	3	1	-	3
CTE-209-E2	Soft Computing Techniques	3	1	-	3
CTE-210-E2	Intersection Design and Analysis	3	1	-	3
CTE-211-E2	Urban Planning Techniques & Practice	3	1	-	3
				Total	16

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work

SEMESTER – III

Sr. No.	Subjects	L	T	P	Credit
Core Courses					
CTE-301	Transportation Economics & Evaluation	3	1	-	3
Elective (any one)					
CSE-301-E1	Advanced Bridge Engineering	3	1	-	3
CWE-302-E1	Hydraulic Structures	3	1	-	3
CTE-304-E1	Pavement Management System	3	1	-	3
CTE-305-E1	Project Appraisals & Development Management	3	1	-	3
Seminar and Dissertation					
CTE-306	Seminar	-	-	4*	2
CTE-307	Dissertation Preliminaries	-	-	8*	8
				Total	16

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work
* Field studies and Studio work.

SEMESTER – IV

Sr. No.	Subjects	L	T	P	Credit
CTE-401	Dissertation	-	-	20	12
	Total	-	-	20	12

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.

NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR
SYLLABUS FOR M.TECH IN TRANSPORTATION ENGINEERING & PLANNING

1ST SEMESTER

MTHM-101 APPLIED STATISTICS

SEMESTER: IST	L	T	P	C
COURSE NO. MTHM-101	3	1	0	3

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:

1. Benjamin J. R., Cornell C. A., Probability Statistics and Decision for Civil Engineers, McGraw-Hill, 1970.
2. Freund J. E., Mathematical Statistics, PHI, New Delhi, 1990.
3. Hines W. W., Montgomery D. C., et. al., Probability and Statistics in Engineering and Management Science, John Wiley and Sons, New York, 1990.
4. Rao S.S., Engineering Optimisation - Theory & Practice, New Age International Publishers, Revised Edition III, 2006.
5. Sharma J.K., Operation Research: Theory & Applications, MacMillan India Ltd., 2000.
6. Bhandarkar P.L., Wilkinson T.S., Methodology & Techniques of Social Research, Himalaya Publishing House, 1991.
7. Gujarati Damodar, Basic Econometrics, Sheldor Ross Publications

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:

1. Bruton M.J., Introduction to Transportation Planning, Hutchinson of London, 1988
2. Chakroborty P., Das N., Principles of Transportation Engineering, PHI,2003
3. Dickey J.W., Metropolitan Transportation Planning, Tata Mc-Graw Hill 1980
4. Hutchinson B.G., Principles of Urban Transportation System Planning, Mc-Graw Hill, 1974.
5. Khisty C J., Lall B.Kent, Transportation Engineering – An Introduction, Prentice-Hall, NJ, 2005
6. Ortuzar, J. D., Willumsen, L.G., Modeling Transport, John Wiley & Sons, 1994
7. Papacostas C.S. and Prevedouros, P.D., Transportation Engineering & Planning, PHI,2002

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:

1. Pignataro, L.J., Traffic Engineering – Theory & Practice, John Wiley, 1985.
2. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, New Delhi, 2002.
3. O'Flaherty C A, Highways- Traffic Planning & Engineering, Edward Arnold, UK
4. Saxena S.C., Traffic Planning & Design, Dhanpat Rai & Sons,New Delhi, 1989.
5. Salter, R J., Highway Traffic Analysis and Design, ELBS.
6. Matson, Smith and Hurd, 'Traffic Engineering' Mc-Graw Hill Book Co.
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.

CGE-101-E1 ENGINEERING BEHAVIOR OF SOILS

SEMESTER: 1ST	**L**	**T**	**P**	**C**
COURSE NO. CTE-106-E1	**3**	**1**	**0**	**3**

Origin and nature of Soils, Mineralogy, Distribution of soils, Clay – water - electrolytes system. Soil fabric and structure. Strength: Effective stress principle. Triaxial tests and applications. Shear strength parameters.

Factors affecting Strength: Structure and texture, porosity, confining pressure, Stress history, Large strain. Hvorslev's parameters, Degree of saturation, Anisotropy, Intermediate principal stress.

Consolidation: Influence of test parameters on results. Consolidation test. Determination of preconsolidation pressure. Triaxial consolidation, Anisotropic, K consolidation. Radial consolidation. Layered system.

Engineering Behaviour of Soils of India: Black cotton soils, Alluvial silts and sands, Aeolian deposits, Laterites, Marine clays, collapsible and sensitive soils.

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-105–E1 COMPUTER APPLICATIONS

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

Introduction: Digital Computer Systems, problem solving techniques, introduction to programming languages, computer language and C++, source programme, Compilation and debugging.

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 Handing, 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
2. Object Oriented Programming with C++ by S.K. Panday.

CTE-107-E1 RAIL AND AIR TRANSPORT ENGINEERING

SEMESTER: IST	L	T	P	C
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:

1. Khanna S.K., Arora M.G., Jain S.S., Airport Planning & Design, Nemchand Bros., Roorkee
2. Horenjeff Robert, The planning & Design of Airports, McGraw Hill Book Co.
3. Saxena S.C., Railway Engineering, Dhanpat Rai & Sons, 1995.

CTE-108-E1 PUBLIC TRANSPORT PLANNING

SEMESTER: 1ST	L	T	P	C
COURSE NO. CTE-108-E1	3	1	0	3

Development of Public Transit System: Historical Growth, Modes of public transport and comparison, public transport travel characteristics, technology of bus, rail, rapid transit systems, basic operating elements.

Transit Network Planning: Objectives, principles, Intercity and Regional transit system, considerations, transit lines – types, geometry and characteristics, transit routes and their characteristics, timed transfer networks, prediction of transit usage, network evaluation, accessibility considerations.

Transit Scheduling: Components, determination of service requirements, scheduling procedure, marginal ridership, crew scheduling.

Transit Infrastructure Facilities: Design of bus stops, design of terminals – principles of good layout, types of layout, depot location, twin depot concept, crew facilities and amenities.

Transit Agency and Economics: Organisational structure of transit agency, management and personnel, transit system statistics, performance and economic measures, operations, fare structure.

References:

1. Vukan R. Vuchic, Urban Transit : Operations, Planning and Economics, Wiley Sons Publishers.
2. Peter White, Public Transport, UCL Press
3. Kadiyali L.R., Traffic Engineering and Transport Planning, Khanna Publishers
4. Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ
5. TCRP Report 30, TCRP Report 95, TCRP Report 100

CSE-103-E2 ADVANCED CONCRETE TECHNOLOGY

SEMESTER: 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 compoisition, Hydration of cement, structure of hydrated cement, special cements, water chemical admixtures.

Concrete: Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength.

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 applicatons.

Concreting Methods: Process of manufacturing of concrete, Methods of Transportation, placing and curing. Extreme weather concreting, Special concreting methods.

References:

1. Neville, A.M. and Brookes, J.J. "Concrete Technology", Pearson Publishers,New Delhi,1994.
2. Neville, A.M. "Properties of Concrete" Pearson Publishers,New Delhi, 2004.
3. Shetty,M.S. "Concrete Technology", S.Chand & Company, New Delhi,2002.
4. Gambhir, M.L. "Concrete Technology", Tata McGraw Hill New Delhi, 1995.
5. Rudhani,G."Light Weight Concrete", Academic Kiado Publishing Home of Hungarian Academy of Sciences,1963.

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:

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers.
2. IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas
3. Salter, R J., Highway Traffic Analysis and Design, ELBS.
4. Edward K. Morlock, Introduction to Transportation Engineering & Planning, International Student Edition, Mc-Graw Hill Book Company, New York.

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 Aggregartes 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:

1. Peurifoy, R.L. and Ledbetter, W.B.; Construction Planning ,Equipment and Methods, McGraw Hill Singapore, 1986.
2. Robertwade Brown; Practical Foundation Engineering Handbook, McGraw Hill Publications, 1995.
3. Joy, P.K.; Total Project Management- The Indian Context, New Delhi, MacMillan India Ltd., 1992.
4. Uliman, John.E, et al; Handbook of Engineering Management, Wiley, New York , 1986.
5. Neville, A.M.; Properties of Concerte, Pitman Publishing Ltd.,London, 1978.

CTE-112-E2 ENVIRONMENTAL IMPACT ASSESSMENT & MANAGEMENT

SEMESTER: IST	L	T	P	C
COURSE NO. CTE-112-E2	3	1	-	3

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

Decision Methods for Evaluation of Alternative:Development of decision matrix. Public participation in environmental decision making, Regulatory requirements, environmental impact assessment process, objectives of public participation, techniques for conflict management and dispute resolution, verbal communication in EIA studies.

References:

1. Canter L.W., Environmental impact assessment, McGraw-Hill, 1997
2. Betty Bowers Marriott, Environmental Impact Assessment: A Practical Guide, McGraw-Hill Professional, 1997.
3. Peter Morris & Riki Therivel, Methods of Environmental Impact Assessment, Routledge, 2001.
4. Denver Tolliver, Highway Impact Assessment, Greenwood Publishing Group, 1993.
5. R. K. Jain, L. V. Urban, G. S. Stacey, H. E. Balbach, Environmental Assessment, McGraw-Hill Professional, 2001.
6. Relevant IRC & CPCB codes.

2ND SEMESTER

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:

1. Yoder and Witezak, Principles of Pavement Design, John Wiley and sons.
2. Yang, Design of functional pavements, McGraw-Hill.
3. Kadiyali L.R., Principles & Practice of Highway Engineering, Khanna Publishers,2003
4. Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee, 2001
5. IRC: 37, Guidelines for the Design of Flexible Pavements (Second Revision).
1. IRC: 58, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (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:

1. Hutchinson, B.G., Principles of Urban Transportation System Planning, Mc-Graw Hill 1974.
2. Oppenheim, N., Applied Models in Urban and Regional Analysis, Prentice-Hall, NJ.
3. Khisty C J., Lall B.Kent, Transportation Engineering – An Introduction, Prentice-Hall, NJ, 2005
4. Chand Mahesh, Puri U. K., Regional in India, Allied Publishers, New Delhi, 1983.
5. Glassion John, Introduction to regional planning, Hutchinson and MIT Press, Cambridge, 1996.
6. Ortuzar J. D., Willumsen L.G., Modeling Transport, John Wiley & Sons, 1994

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

CTE-204 TRAFFIC FLOW THEORIES

SEMESTER: 2ND	L	T	P	C
COURSE NO. CTE-204-E2	3	1	0	3

Traffic Stream Characteristics: Measurement, microscopic and macroscopic Study of Traffic Stream Characteristics - Flow, Speed and Concentration; Use of Counting, Interval and Translated Distributions for Describing Vehicle Arrivals, Headways, Speeds, Gaps and Lags; Fitting of Distributions, Goodness of Fit Tests, gap acceptance.

Traffic Stream Models: Fundamental Equation of Traffic Flow, Speed-Flow-Concentration Relationships, Normalised Relationship, Fluid Flow Analogy Approach, Shock Wave Theory, Platoon Diffusion and Boltzman Like Behaviour of Traffic Flow, Car-Following Theory, Linear and Non-Linear Car-Following Models, Acceleration Noise

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.

Highway Capacity & Level-of-Service Studies: Concepts, Factors Affecting Capacity & Level-Of Service, Capacity Analysis of Different Highway Facilities, Passenger Car Units, Problems in Mixed Traffic Flow.

Traffic Simulation: System Simulation, Simulation Languages, Generation of Random Numbers, Generation of Inputs – Vehicle Arrivals, Vehicle Characteristics, Road Geometrics, Design of Computer Simulation Experiments.

References:

1. TRB - SR No.165 - Traffic Flow Theory, Transportation Research Board, Washington - D.C.
2. May, A D., Traffic Flow Fundamentals, Prentice-Hall, NJ
3. Drew, D.R., Traffic Flow Theory and Control, McGraw-Hill, New York.
4. TRB Special Report 209: Highway Capacity Manual, Transportation Research Board,
5. Washington DC, 1985.
6. Wohl M. and Martin, B V., Traffic System Analysis for Engineers and Planners, McGraw-Hill, New York.
7. McShane W R & Roess R P, Traffic Engineering, Prentice-Hall, NJ
8. Neylor, T.H. et al., Computer Simulation Techniques, John Wiley.

CGE-201-E2 GROUND IMPROVEMENT TECHNIQUES

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

1. Bowles, J. E.,Foundation Analysis and Design, McGraw-Hill International Edition, 1997.
2. Hausmann, M. R.,Engineering Principles of Ground Modification, McGraw-Hill International Editions, 1990.
3. Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A. Balkema, 1966.
4. Moseley, M. P.,Ground Improvement , Blackie Academic & Professional, 1993.
5. Xanthakos, P. P., Abramson, L. W. and Bruce, D. A, Ground Control and Improvement, John Wiley & Sons, 1994.
6. Soil Stabilization: Ingles, O. G. & Metcalf, J. B.
7. Koerner, R. M, Designing with Geosynthetics, Prentice Hall, 1993.

CTE-206-E1 GEOMETRIC DESIGN OF HIGHWAYS AND STREETS

SEMESTER: 2ND	**L**	**T**	**P**	**C**
COURSE NO. CTE-206-E1	**3**	**1**	**0**	**3**

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:

1. Kadiyali L.R., Principles & Practice of Highway Engineering, Khanna Publishers,2003
2. Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee, 2001
3. Relevant IRC codes: IRC:32, IRC:38, IRC:39, IRC:64, IRC:66, IRC:73, IRC:80, IRC:86, IRC:92, IRC:103, IRC:106, IRC:SP:23, IRC:SP:41

CTE-207-E1 ROAD SAFETY & ENVIRONMENT

SEMESTER: 2ND	**L**	**T**	**P**	**C**
COURSE NO. CTE-207-E1	**3**	**1**	**0**	**3**

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
2. Wohl M., Martin B.V., Traffic system analysis of Engineers & Planners, McGraw Hill, New York.
3. Babkov V.F., Road conditions & Traffic Safety, MIR Publishers, Moscow, 1975
4. Kadiyali L.R., Traffic Engineering & Transport Planning, Khanna Publishers, 2003
5. Little A.D., The state of art of Traffic Safety, Paraeger Publishers, New York, 1970
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**

Management Decisions: Concepts, Operation research. Decision environment, Decision making processes.

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.

Discrete event simulation; Generation of random variables, simulation processes and languages. Network models. Shortest path method, maximum flow. Minimum spanning tree problem.

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
2. Ravindran, D.T.Philips and J.J.Solberg, Operations Research; Principles and Practice, John Wiley, 2nd Edition 1987
3. S.Bazzarra, J.J.Jarvis and H.D.Sherali, Linear Programming and Network Flows, 2nd Edition , John Wiley, 1990
4. L.Winston, Operations Research; Application and Algorithms, Kent P.W.S. 2nd Edition, 1991
5. A.Taha, Operations Research; An Introduction, MacMillan, 1982
6. Kapoor, Computer Assisted Decision Models Tata McGrw-Hill, New Delhi, 1991
7. Neylor, T.H. et al., Computer Simulation Techniques, John Wiley.

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**

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.
GIS Data Processing, Analysis and Modeling: Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts, and nearest neighbour analysis – Network analysis – Surface modeling – DTM.

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:

1. Ian Heywood, S. Cornelius and S. Carver, An Introduction to Geographical Information Systems, Pub. By Pearson Education (Singapore) Pvt. Ltd., Printed in Replica Press Pvt. Ltd., India, 2001
2. Agarwal, N. K., Essentials of GPS, Spatial Networks Pvt. Ltd., Hyderabad, 2004.
3. Lo, C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2002.
4. Anji Reddy, M., Remote Sensing and Geographical Information Systems, B.S.Publications, Hyderabad, 2001.
5. Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
6. Clarke, K., Getting Started with Geographic Information Systems, Prentice Hall, New Jersy, 2001.
7. DeMers, M.N., Fundamentals of Geographic Information Systems, John Wiley & Sons, New York, 2000.
8. Kennedy M., The Global Positioning System & GIS: An Introduction, Ann Arbor Press, 1996
9. Thomas, M. Lillisandand R.W.Kiefer; Remote Sensing and Image Interpretation, John Wiley, 1987.
10. Sabins and Floyd, F.J.R; Remote Sensing Principles and Interpretation, W.H. Freeman, Sanfrancisco, 1978.
11. C. Elachi; Introduction to Physics and Techniques of Remote Sensing, New York Wiley, 1987.
12. Phillip, H. Swain and Shirley, M. Davis; Remote Sensing- The Quantitative Approach, McGraw Hill Publications , 1978.
13. Johnson, R. Jenson; Introductory Digital Image Processing, Prentice hall , 1986

CWE-203-E2 GROUND WATER HYDROLOGY

SEMESTER: 2ND	**L**	**T**	**P**	**C**
COURSE NO. CWE-203-E2	**3**	**1**	**0**	**3**

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:

1. El-Kadi A.; Ground water Models for Resource Analysis and Management, Lewis Publications, Boca Raton.

2. S. Ne-Zheng; Inverse Problems in Ground water Modelling, Kluwer Academic Dordrecht.
3. USEPA; Handbook of Groundwater, Vols. I & II, Scientific Publications, Jodhpur Reprint.
4. E. Custodio(Editor); Study and Modelling of Salt water Intrusion into Aquifers, CIMNE publications, Barcelona, Spain.
5. Walton W.c.; Groundwater Modellling Utilities, Lewis Publications, Boca-Raton.
6. Karanth K.R.; Groundwater Assessment Development and Management, Tata McGraw Hill New Delhi.
7. R. Willis and W.W.G. Yeh; Groundwater Systems Planning and Management, Prentice Hall New Jersey.
8. Todd D.K. , Groundwater Hydrology, John Wiley & Sons.

CTE-209-E2 SOFT COMPUTING TECHNIQUES

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

Genetic Algorithms: Goals of optimization - Comparison with traditional methods - Schemata – Terminology in GA – Strings, Structure, Parameter string - Data Structures – Operators - Coding fitness function – Algorithm - Applications.

Fuzzy Logic: Concepts of uncertainty and imprecision – Sets - Concepts, properties and operations on Classical sets & Fuzzy Sets - Classical & Fuzzy Relations - Membership Functions - Fuzzy Logic – Fuzzification - Fuzzy Rule based Systems – Fuzzy propositions - Applications.

Artificial Neural Networks: Basics of ANN; Models of a Neuron – Topology: Multi Layer Feed Forward Network (MLFFN), Radial Basis Function Network (RBFN), Recurring Neural Network (RNN) – Learning Processes: Supervised and unsupervised learning. Error-correction learning, Hebbian learning; Single layer perceptrons - Multilayer perceptrons - Least mean square algorithm, Back propagation algorithm Applications.

Hybrid Systems: Fuzzy neural systems – Genetic Fuzzy Systems – Genetic Neural Systems.

References:

1. Timothy J.Ross, Fuzzy Logic with Engineering Applicatios, McGraw-Hill
2. Simon Haykin, Neural Netwroks, PrenticeHall
3. J.M. Zurada, .Introduction to artificial neural systems., Jaico Publishers
4. H.J. Zimmermann, Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.
5. Suran Goonatilake, Sukhdev Khebbal (Eds), .Intelligent hybrid systems., John Wiley & Sons, New York, 1995

CTE-210-E2: INTERSECTION DESIGN AND ANALYSIS

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

Types of intersections, Principles of design, types of manoeuvres, relative speed, conflict points and area, Intersection geometrics and their influence on design/operation.

Concept of capacity and LOS, Operational analysis of two-way and all-way stop controlled intersections and Roundabouts by US and Indian methods, mini roundabouts.

Analysis of signal controlled intersections by US, British and Swedish methods, delay and its evaluation. Types of signals, Design of signals by Indian, US and British methods, signal coordination.

Grade separated intersections and interchanges, weaving sections and their operational evaluation, Intersection signs, marking and lighting

References:

1. Transportation Engineering & Planning, by C. S. Papacostas and P. D. (2001 or later)
2. Principles of Highway Engineering and Traffic Analysis, by Fred L Mannering, Walter P. Kilareski and Scott S. Washburn, Wiley India Edition (2007 or later)
3. Transportation Engineering, by C. Jotin Khistya and B. Kent Lall Prentice Hall of India Private Limited, New Delhi (2006 or later)
4. Transport Planning and Traffic Engineering, by C A O Flaherty, Hodder Headline Group, London (1997 or later)
5. Highway Capacity Manual of US, Transportation Research Board, Washington DC (2010)

CTE-211-E2 URBAN PLANNING TECHNIQUES AND PRACTICE

SEMESTER: 2ND	**L**	**T**	**P**	**C**
COURSE NO. CTE-211-E2	**3**	**1**	**0**	**3**

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

Spatial standards: Spatial standards for residential, industrial, commercial and recreational areas, space standards for facility areas and utilities, Process of implementation, Provisions of Town Planning Act, zoning, subdivision practice, metro region concept.

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

Town Development Plan: Scope, contents and preparation. A case study of development plan, scope, content and preparation of zonal development plans, plan implementation - organisational legal and financial aspects, public participation in plan formulation and implementation.

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.

Recent Trends & Practices: In planning and development system in India, Outline of planning and development system in U.K., U.S.A. and U.S.S.R..

References:

1. Margaret Roberts, Town Planning Techniques, Hutchinson Educational Publication.
2. Modak N.V., Ambedkar V.N., Town and Country Planning and Housing, Orient Longman Limited.
3. Gupta R.G., Planning and Development of Towns, New Delhi.
4. Ramegauda K.S., Urban and Regional Planning, Mysore University Publication.

3RD SEMESTER

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 o social accounting frame work.

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:

1. Winfrey R, Highway Economic Analysis, International Textbook Company.
2. Kenneth J. Button, Transport Economics, Elgar
3. David A. Hensher, Ann M. Brewer, Transport : An Economics and Management Perspective, Oxford University Press
4. Emile Quinet, Roger Vickerman, Principles Of Transport Economics, Edward Elgar Pub
5. Road User Cost Study, Central Road Research Institute
6. Ian G. Heggie, Transportation Engineering Economics, McGraw Hill.
7. IRC:SP:30-1993, Manual on Economic Evaluation of Highway Projects in India

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 foundatiuons, foundation failures, foundation setting, cofferdams

Bridge Super structure: Superstrcuture 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

CWE -302-E1 HYDRAULIC STRUCTURES

SEMESTER: 3RD L T P C
COURSE NO. CWE -302-E1 3 1 0 3

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.
Design procedure for irrigation channels, Irrigation outlets, Canal masonary works, - principles of design, use of flow net, Khosla's theory , Regulation works - Falls, distributory head regulators, Cross regulators, Canal head Works, Earth Dams, Gravity Dams, Spillways and Energy dissipators , Escapes , Trench weirs , Supply channel and head regulator.

References:

1. R.S. Varshney, S.C. Gupta and R.L. Gupta; Theory and Design of Irrigation Structures, Nemchand & Brothers ,Roorkee, 1992.
2. R.k. Sharma; Irrigation Engineering and Hydraulic Structures, Oxford and IBH Publishing Co., New Delhi, 1984.
3. Arora, K.R. " Irrigation water power and Water Resources Engineering", Standard Publishers Distributors, Delhi,2002.
4. L. R. Kadiyali and N. B. Lal; Principles and Practices of Highway Engineering, Khanna Publishers Delhi, 2005

CTE-304-E1 PAVEMENT MANAGEMENT SYSTEM

SEMESTER: 3RD L T P C

COURSE NO. CTE-304-E1 3 1 0 3

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:

1. Haas R. C. G., Hudson W. Ronald, Zaniewski John P., Modern Pavement Management, Krieger Publishing Company, 1994
2. Oecd, Pavement Management Systems, O E C D 1987.
3. Shahin M. Y., Pavement management for airport, roads and parking lots, Chapman and hall 1994
4. Susan Brown, Pavement Management Systems, Transportation Research Board, 1993.

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

Project Appraisals: Types of appraisals, Project cost, Project financing, Economic evaluation methods, Case Studies of Projects, Environmental Appraisal, Financing of transport infrastructure, Public – Private Partnership-BOT, BOOT etc., Risk & Sensitivity analysis, Break even analysis.

Philosophy of Management, Project Organisation, Management Techniques, Network approach, Project Planning Software applications, Safety management, Labour organization and labour laws, Project cost & time management, Management Case Studies.

Development Management: Concepts, components, principles, organizational structures of urban Local Government, functions & responsibilities, related Municipal Corporation Act, Town Planning Act, case studies of organizational structures of metropolitan cities in India.

References:

1. Nicholas, J., M., Project Management for Business & Technology, PHI (2002)
2. Mathur B.L., Project Management, Arihant publications House, Jaipur, 1994
3. Ghosh S., Project Management & Control, New Central Book Agency Ltd., 1997
4. Goel B.B., Project Management, Deep & Deep Publication, New Delhi, 1987
5. Municipal Corporation Act and Town Planning Act.

CTE-306 SEMINAR

SEMESTER: 3RD	**L**	**T**	**P**	**C**
COURSE NO. CTE-306	**0**	**0**	**4**	**2**

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	**L**	**T**	**P**	**C**
COURSE NO. CTE-307	**0**	**0**	**8**	**8**

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	**L**	**T**	**P**	**C**
COURSE NO. CTE-401	**0**	**0**	**25**	**12**

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.

MTHM-111-E2 ~~Numerical Methods~~

SEMESTER: IST	**L**	**T**	**P**	**C**
COURSE NO. MTHM-111-E2	**3**	**1**	**-**	**3**

Numerical analysis, finite differences, interpolation, numerical solution of algebraic and transcendental equations, iterative algorithms, convergence, Newton-Raphson procedure

Solution of polynomial and simultaneous linear equations

Numerical integration, Euler-Maclaurin formula, Newton-Cotes formula, error estimates

Numerical solutions of ordinary differential equations: method of Euler, Taylor, Adams Runge-Kutta and predictor-corrector procedures, stability of solution, solution of boundary value problems, finite differences techniques, stability and convergence of solution, finite element method.

Special functions. Legendre's special function, Rodrigue's formula, generating functions for Legendre's polynomials and recurrence formulae, Bessel's function, recurrence formulae, Bessel's function of integral order.

References:

1. Numerical methods for Scientists and Engineers by M.K. Jain, S.R. Iyengar & R.K. Jain, Wiley Eastern Ltd.
2. Mathematical Numerical Analyis By S.C. Scarborough, Oxford and IBH Publishing Company.
3. Introductory methods in Numerical Analysis by S.S. Sastry, Prentice Hall of India.
4. Theory and problems in Numerical Methods by T. Veeranjan and T. Ramachandran, Tata McGraw-Hill Publishing Company, New Delhi.
5. Numerical Methods for Mathematics Sciences and Engineering 2nd ed. By John H. Mathews, Prentice Hall of India, New Delhi.
6. Advanced Engineering Mathematics by R.K. Jain & S.R.K. Iyengar, Narosa-.