Course Structure & Syllabi
Of
M. Tech Programme
in
Civil Engineering

Specialization:
Transportation Engineering

(From the Session 2016-17)

VSSUT, BURLA

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA

DEPARTMENT OF CIVIL ENGINEERING

VISION

To emerge as an internationally acclaimed Civil Engineering Department for imparting futuristic technical education and creation of vibrant research enterprise to create quality civil engineering and researchers, truly world class leader and unleashes technological innovations to serve the global society and improve the quality of life.

MISSION

The Department of civil Engineering, VSSUT, Burla strives to create values and ethics in its product by inculcating depth and intensity in its education standards and need based research throughout

- Participative learning in a cross-cultural environment that promotes the learning beyond the class room.
- Collaborative partnership with industries and academia within and outside the country in learning and research.
- Encouraging innovative research and consultancy through the active participation and involv ement of all faculty members.
- Facilitating technology transfer, innovation and economic development to flow as natural re sults of research where ever appropriate.
- Expanding curricula to cater broader perspectives.
- Creation of service opportunities for upliftment of the society at large.

PROGRAMME EDUCATIONAL OBJECTIVES:

- **PEO-I:** Study of transportation engineering provides opportunities for understanding the transportation problems and identification of the needs.
- **PEO-II:** To find a safe, efficient, cost effective, sustainable transportation system through the land-use transportation planning, infrastructure planning, design, construction, management and environmental protection measures.

PROGRAMME OUTCOMES:

- Ability to identify, formulate and solve complex transportation problems and research need.
- Ability to apply knowledge of mathematics, science, economics, statistics and engineering to solve complex problems in transportation.
- .Ability to plan, design, and implement safe, efficient, cost effective, sustainable transportation projects to meet societal and environmental needs.
- Ability to design and conduct complex transportation engineering experiments, surveys as well as to analyze and interpret the experimental/ collected data.
- Ability to use the techniques, skills, and modern engineering tools necessary for transportation engineering practices.
- Ability to assess impact of contemporary social/ political issues on professional practices.
- Ability to recognize the sustainability and environmental impact of the transportation engineering projects.
- Ability to follow prescribed norms, responsibilities and ethics in engineering practices.
- Ability to work effectively as an individual and in a team.
- Ability to communicate effectively through oral, written and pictorial means with engineering community and the society at large.
- Ability to recognize the need for and to engage in lifelong learning
- Ability to understand and apply engineering and management principles in executing projects.

M.TECH. (TRANSPORTATION ENGINEERING)

VISION:

Our vision is to equip the students with development of analytic, problem-solving planning, design, construction and management skills suitable for safe, efficient, cost-effective, sustainable public and private transportation to support economic, social & strategically growth of the nation.

MISSION:

- Understanding of the problems and identification of the needs related to transportation.
- Planning, designing, construction and operation of a safe, efficient, cost-effective integrated multi-modal transportation system.
- Conducting research in the field of transportation including planning; design, construction & operation and related work in economics, finance & administration.

PROGRAMME EDUCATIONAL OBJECTIVE:

Study in the field of transportation engineering provides opportunities for understanding the transportation problems and their solutions through the sustainable land-use transportation planning, infrastructure planning, design, construction, management and environmental protection measures.

PROGRAMME OUTCOMES:

- Ability to apply knowledge of mathematics, science, economics, statistics and engineering to solve complex problems in transportation engineering.
- Ability to identify, formulate and solve complex transportation engineering problems using principles of mathematics, statistics, basic science & engineering.
- Ability to plan, design, implement & evaluate transportation engineering projects to meet societal and environmental needs.
- Ability to design and conduct complex transportation engineering experiments, surveys as well as to analyze and interpret the experimental/ collected data.
- Ability to use the techniques, skills, and modern engineering tools necessary for transportation engineering practices.
- Ability to assess impact of contemporary social/ political issues on professional practices.
- Ability to recognize the sustainability and environmental impact of the transportation engineering projects.
- Ability to follow prescribed norms, responsibilities and ethics in engineering practices.
- Ability to work effectively as an individual and in a team.
- Ability to communicate effectively through oral, written and pictorial means with engineering community and the society at large.
- Ability to recognize the need for and to engage in lifelong learning
- Ability to understand and apply engineering and management principles in executing projects.

COURSE STRUCTURE

I YEAR - I SEMESTER

Code	Subject	L	T	P	Credit
MCE2166	Traffic Engg. & Management (same as CE 15070)	4	0	0	4
MCE2131	Transportation Infrastructure Design	4	0	0	4
MCE2132	Pavement Materials Characterization	4	0	0	4

	Elective –I	4	0	0	4
	Elective- II	4	0	0	4
MCE2178	Transportation Engineering Lab	0	0	6	4
MCE2179	Seminar-I	0	0	3	2
MCE2180	Comprehensive viva voce –I	0	0	0	2
	Total	20	0	9	28

I YEAR -II SEMESTER

Code	Subject	L	T	P	Credit
	Traffic Analysis	4	0	0	4
	Highway construction practice	4	0	0	4
	Pavement Analysis and Design	4	0	0	4
	Elective –III	4	0	0	4
	Elective- IV	4	0	0	4
	Transportation Engineering Design	0	0	6	4
	Seminar-II	0	0	3	2
	Comprehensive viva voce –II	0	0	0	2
	Total	20	0	9	28

II YEAR -III SEMESTER

Code	Subject	L	T	P	Credit
	Dissertation interim evaluation				10
	Comprehensive Viva Voce -III				3
	Seminar on Dissertation				2
	Total				15

II YEAR -IV SEMESTER

Code	Subject	L	T	P	Credit
	Dissertation Open Defense				5
	Dissertation evaluation				20
	Total				25

Grand Total = 96

Elective- I & II

Sl. No.	Subject
1	Computational and statistical methods (Same as M. Tech.- WRE)
2	Project Management (same as CE 15067)

3	Remote sensing and GPS for Transportation Engineering
4	Urban Transportation Policy Planning for Sustainable Development
5	Rural Roads
6	Transportation System Management
7	Transportation Safety & Environment
8	Public Transportation
9	Highway Project Formulation & Economics

Elective- III & IV

Sl. No.	**Subject**
1	Intelligent transportation systems
2	Pavement Construction Maintenance and Management
3	Optimization Techniques
4	GIS Applications in transportation Engineering
5	Environmental Impact Assessment (same as M-Tech. –ESE)
6	Concrete Technology (same as CE 15047)
7	Bridge Engineering (same as CE 15049)
8	Planning and Design of Airports
9	Land Use Transportation Modelling
10	Ground Improvement Techniques (same as CE 15046)

DETAILED SYLLABI

M. Tech – I year, I Sem. (Transportation Engineering)

TRAFFIC ENGG & MANAGEMENT (4-0-0) CR-04

Course Objectives:

- To learn traffic studies, their analysis and their interpretation.
- To learn analysis of LOS.
- To learn design of signal.
- To learn transportation system management.

Module I (10 Hours):
Traffic Studies: Basic characteristics of Traffic, Volume, Speed and Density; Definitions and their interrelationships; Traffic Volume studies - Objectives, Methods of Volume counts, Presentation of Volume Data; Speed studies- Types of Speeds, Objectives, Methods of speed studies, Statistical Methods for speed data Analysis, Presentation of speed data. Delay Studies; Head ways and Gap Studies - Headway and Gap acceptance, Origin and Destination Studies.

Module II (10 Hours):
Parking Studies: parameters of parking, definitions, Parking inventory study, Parking survey by Patrolling method; Analysis of Parking Survey data; Accident studies- Causative factors of Road accidents, Accident data collection: Accident analysis and modelling; Road Safety Auditing, Measures to increase Road safety.

Module III (10 Hours):
Signal Designing – Fixed Time signals, Determination of Optimum Cycle length and Signal setting for Fixed Time signals, Warrants for Signals, Time Plan Design for Pre-Timed Control- Lane group analysis, Saturation flow rate, and Adjustment factors, Uniform and Incremental Delay, Vehicle Actuated Signals, Signal Coordination.

Module IV (10 Hours):
Capacity and LOS Analysis: Introduction to Traffic capacity Analysis, Concepts of Level of Service, Basic definitions, Factors affecting Capacity and LOS, Capacity of Urban/Rural Highway, With or without access control, Basic freeway segments - Service flow rate of LOS, Lane width or Lateral clearance adjustment; Heavy vehicle adjustment; Driver population adjustment.

Transportation System Management - Measures for Improving vehicular flow – one way Streets, Signal Improvement, Transit Stop Relocation, Parking Management, Reversible lanes- Reducing Peak Period Traffic - Strategies for working hours, Congestion Pricing, Differential Toll Policies**.**

Text Books:

1. Transportation Engineering - An Introduction - C.Jotin Khisty, Prentice Hall Publication
2. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers

Reference Books:

1. Traffic Engineering - Theory & Practice - Louis J.Pignataro, Prentice Hall Publication.
2. Traffic Engineering by Roger P.Roess, William R. Mc. Shane, Elena S.Prassas, PrenticeHall, 1977.

3. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India
4. Fundamentals of Traffic Engineering – McShane & Rogers.
5. Principles of Highways Engineering and Traffic Analysis - Fred Mannering & Walter Kilareski,John Wiley & Sons Publication
6. IRC Codes
7. Highway Capacity Manual -2010.

Course Outcomes:

- Ability to conduct traffic survey, collects data, analyse and interpret them.
- Ability to analyse LOS of an operating highway.
- Ability to design of signal and manage the traffic.

TRANSPORTATION INFRASTRUCTURE DESIGN: (4-0-0) CR-04

Course Objectives:

- To learn Geometric Design of Cross Sectional Elements of various types of roads.
- To learn Geometric Design of Horizontal Alignment of Roads
- To learn Geometric Design of Vertical Alignment of Roads.
- To learn transportation system management

Module I (10 Hours):

Functional Classification of Highway System Controlling factors – Topography, Traffic Characteristics, Capacity and Level of Service, Design Speed. Objectives of Geometric Design, Cross Section Elements: Design specifications; Pavement Surface characteristics – Skid Resistance, Road Roughness; Camber, Objectives, design standards. Specifications for hill roads.

Module II (10 Hours):

Horizontal Alignment of Roads: Sight Distances – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance ;Elements of horizontal curves; Super elevation; Extra-widening on Curves, setback distance, radius; Transition Curves – Objectives and Design.

Module III (10 Hours):

Vertical Alignment of Roads: Gradients – Types of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves and Design criteria for Vertical Curves; Importance of Sight Distances for Horizontal and Vertical Curves , Grade Compensation

Module IV (10 Hours):

Geometric Design of Intersections : Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelization, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards. Miscellaneous Elements: Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays – Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design, Traffic Signs and Markings.

Text book:

1. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal.

Reference books:

1. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
2. IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas.

Course outcomes:

- Ability to Design geometric elements of Cross Section of various types of roads.
- Ability to Design geometric elements of Horizontal Alignment of Roads
- Ability to Design geometric elements of Vertical Alignment of Roads.
- Ability to design various devices for traffic management.

PAVEMENT MATERIALS AND CHARACTERIZATION: (4-0-0) CR-04

Course Objectives:

- To learn about characteristic of subgrade soil.
- To learn about characteristic of road aggregates.
- To learn about characteristic of paving grade bitumen.
- To learn about characteristic of cement used in road construction.

Module I (10 Hours):

Sub-grade Soil Characterization: Soil Classification; Index & Engineering properties of soil, Properties of sub-grade; Mechanical response of soil; A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz CBR, Plate Load test, resilient modulus, DCPT, Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control. Introduction to Soil Stabilization: Physical and Chemical modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen

Module II (10 Hours):

Aggregate Characterization: Origin, Classification, Types of aggregates; Sampling of aggregates; Mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; Proportioning and Blending of aggregates: Super pave gradation, Fuller and Thompson's Equation, 0.45 power maximum density graph; Use of locally available materials in lieu of aggregates.

Module III (10 Hours):

Bitumen Characterization: sources, Composition of bitumen, Rheology of bitumen, types of bituminous material, properties of bitumen.

Properties of Bituminous Mixes: Elastic modulus, Dynamic modulus; stiffness modulus using shell nomographs; visco-elastic and fatigue, creep test; Resilient modulus, Complex (Dynamic) Moduli of Bituminous Mixes.

Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFO and PAV. Design of bituminous mixes: Marshall's specifications; Introduction to super pave mix design procedure

Module IV (10 Hours):

Cement and Cement Concrete Mix Characterization: Types of cements and basic properties; Quality tests on cement; Tests on cement concrete including compressive strength, flexural strength, modulus of elasticity and fatigue properties.

Text book:

1. Das, A. And Chakroborty, P. Principles of Transportation Engineering, 1st Edition, PHI Publication.

Reference books:

1. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice-Hall.
2. Kerbs Robert D. and Richard D. Walker, Highway Materials, McGraw-Hill, 1971.

3. Relevant IRC and IS Codes of Practices (Separate List will be given).

Course Outcomes:

- Ability to characterise subgrade soil.
- Ability to characterise road aggregates.
- Ability to characterise paving grade bitumen.
- Ability to characterise cement used in road construction.

ELECTIVE- I & II

COMPUTATIONAL AND STATISTICAL METHODS : (4-0-0) CR-04

Course Objectives:

- To learn about numerical solutions to differential equations.
- To learn finite element method.
- To learn about different types of probability distributions.
- To learn about regression analysis.

Module I (10 Hours):

Numerical Solution of Ordinary Differential Equations-Solution by Taylors's Series-Euler's Method-Runge Kutta Methods-Simultaneous and Higher Order Equations-Boundary Value Problems-Applications. Finite Difference Method-Finite Difference. Representation of Differential Equations-Stability-Consistency and Convergence of Partial Differential Equations-Time integration-Finite Difference Methods in Solution of Steady and Unsteady Problem-Jacobi's Method, Gauss Seidel Method, Successive Over Relaxation Method and Method of Characteristics-Application and Examples.

Module II (10 Hours):

Finite Element Method-Basic Concepts – Solution of Discrete Problems-Steady State and Time Dependent Continuous Problems-Application of Finite Method through illustrative Examples.

Classification and Presentation of Data – Basic Concepts of Probability – Probability Axioms – Analysis and Treatment of Data – Population and Samples – Measures of Central Tendency – Measures of Dispersion- Measures of Symmetry – Measures of Peakedness.

Module III (10 Hours):

Probability Distributions – Discrete and Continuous Probability Distribution Functions – Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distributions, Extreme Value Distributions – Transformations to Normal Distributions, Selecting A Probability Distribution, Parameter Estimation – Method of Moments, Method of Maximum Likelihood, Probability Weighted Moments and Least Square Method, Joint Probability Distributions.

Module IV (10 Hours):

Regression Analysis – Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypotheses – Multiple Linear Regression – Correlation and Regression Analysis

Reference books:

1. Akai, T.J,(1994) “Applied Numerical Methods for Engineers”, John Wiley Inc., New York
2. Haan C.T. (1995), “Statistical Methods in Hydrology”,. East West Press, New Delhi
3. Huyorkon, P.S. and Pinder, G.F.: “Computational Methods in Subsurface Flow”, Academic Press, 1983.
4. Press, W.H., Flannery B.P. and Tenklsky, S.A. and Vetterling, W.T. “Numerical Recipes-The Art of Scientific Computing”, Cambridge University Paress, Ccmbridge, 1994.
5. Kosho, B (1997), “Neural Networks and Fuzzy Systems”, Prentice Hall of India, N Delhi
6. Rao V and H. Rao, (1996), “C++ Neural Networks and Fuzzy Logic, BPB Publications, New Delhi”

Course Outcomes:

- Ability to use numerical solutions to differential equations.
- Ability to apply finite element method.
- Ability to fit different types of probability distributions to transportation situation.
- Ability to develop regression models.

PROJECT MANAGEMENT: (4-0-0) CR-04

Course Objectives:

- To learn characteristics of a project.
- To learn Project scheduling and Planning.
- To learn about project analysis.
- To learn Computers applications in Project Management.

Module-I (10 Hours):

Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization. Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management.

Module-II (10 Hours):

Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks. Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource Constraints: Resource Levelling and Resource Allocation. Specific methodologies for planning: Critical Path Method (CPM); Precedence Diagramming Method (PDM); Program Evaluation and Review Technique (PERT); Graphical Evaluation and Review Technique (GERT); Queue - Graphical Evaluation and Review Technique (GERT); Simulation Language for Alternative Modelling (SLAM); Dynamic Planning and Control Methodology (DPM); Critical Chain Planning; Resource Loading.

Module-III (10 Hours):

Time Cost Trade off: Crashing Heuristic. Project Implementation: Project Monitoring and Control

with PERT/Cost, Contract Management, Project Procurement Management; Post Project Analysis. life-cycle and post-mortem analysis.

Module-IV (10 Hours):
Computers applications in Project Management, Such as Microsoft® Project, Primavera Project Planner®, Primavera® Monte Carlo, Crystal Ball® and ProChain® are available to the project manager for deterministic and probabilistic planning.
Primavera® P3 — for deterministic time and resource scheduling; Primavera® Monte Carlo — for probabilistic time and resource scheduling; Primavera® Expedition — for documenting multiple and complex projects; Pro Chain® — for scheduling with the critical chain method; Crystal Ball® — for risk analysis; Vensim® — for system dynamics analysis

Text books:

1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, PH Inc.
2. Lock, Gower, Project Management Handbook.

Reference books:
1. Cleland and King, VNR Project Management Handbook.
2. Wiest and Levy, Management guide to PERT/CPM, PHI.
3. Horald Kerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002.
4. S. Choudhury, Project Scheduling and Monitoring in Practice.
5. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.

Course Outcomes:

- Ability to characterise a project.
- Ability to schedule and plan a project.
- Ability to analyse the project.
- Ability to manage a project through the use of computer applications.

REMOTE SENSING & GPS FOR TRANSPORTATION ENGINEERING: (4-0-0) CR-04

Course Objectives:

- To learn the basics and characteristics of remote sensing.
- To learn pre-processing of remotely sensed data.
- To learn about information extraction techniques.
- To learn basics and application of GPS in transportation engineering.

Module -I (10 Hours):

Remote Sensing: Basic Principles – Introduction, Electromagnetic waves and its properties, interaction with Earth surface materials, recent developments in Remote sensing, Social and legal implications of Remote Sensing, status of Remote Sensing. Characteristics of imaging remote sensing instruments, satellite remote sensing system – a brief over view, other remote sensing satellites.

Module -II(10 Hours):

Pre-Processing Of Remotely Sensed Data: Introduction, cosmetic operation; Geometric connection and registration, atmospheric correction. Image Transforms: Introduction, arithmetic operations, empirically based image transforms, Principal component analysis, multiple discriminant analysis etc.

Module -III(10 Hours):

Enhancement Technique and Filtering Techniques: Introduction, human visual system, contrast enhancement; Pseudo colour enhancement. Thematic information extraction, classification and accuracy assessment and change detection. Hyper spectral and radar sensors Filtering Technique Classification Low-pass (smoothing filters) High pass (sharpening) filters, edge detection, frequency domain filters, geometrical basis, classification, unsupervised and supervised classification, classification accuracy. Rectification of digital land satellite imagery. Image enhancement, spectral and spatial filtering

Module -IV (10 Hours):

Global Positioning Systems: Introduction, Elements of satellite surveying, global positioning system, GPS satellites, Adjustment computations, GPS observables, GPS- space segment, Control segment, User segment, GPS satellite signals, Receivers; Static, Kinematic and Differential GPS .

Applications of Remote sensing and GPS in Transportation Engineering: Intelligent Transport System, Urban Transport Planning, Accident Studies, Transport System Management, Road Network Planning

Text book:

1. GPS Satellite Surveys, Alfred Leick, Willey & Sons

Reference books:

1. Principles of Remote Sensing, Paul Jumani, ELBS, 1985.
2. Computer processing of remotely sensed Images an Introduction – Paul M.Mather, John Wiley & Sons, 1989.

Course Outcomes:

- Ability to understand the basics and characteristics of remote sensing.
- Ability to process remotely sensed data.
- Ability to draw information from remotely sensed data.
- Ability to understand the basics and application of GPS in transportation engineering

URBAN TRANSPORTATION POLICY AND PLANNING FOR SUSTAINABLE DEVELOPMENT :(4-0-0) CR-04

Course Objectives:

- To learn the planning methodology of Urban transportation systems.
- To learn methods of data collection for planning.
- To learn about travel demand models.
- To learn Planning for sustainable urban mobility.

Module-I (10 Hours):

Introduction: Role of transportation in the economic development of nations, overview of transport modes, growth trends, National Transport Policy of India – Case studies, transportation planning in the developing world; and comparative international transportation policies; Fundamentals of transportation , Principles of planning, evaluation, selection, adoption, financing, and implementation of alternative urban transportation systems; formulation of community goals and objectives, inventory of existing conditions; transportation modelling trip generation, distribution, modal choice, route assignment

Module-II (10 Hours):

Data Collection And Inventories: Collection of data – Organization of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

Module-III (10 Hours):

Travel Demand issues: Trends, Overall Planning process, Long term Vs Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation, Detailed approach on 4 step travel demand estimation; Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques.

Module-IV (10 Hours):

Demand and supply planning : Planning for sustainable urban mobility, positive and negative externalities in urban transport, congestion pricing, parking policy, demand management , Urban travel and transportation system characteristics - a systems perspective, Data management and use in decision making , Demand analysis , Urban activity analysis, Supply analysis; Plan Preparation And Evaluation: Travel Forecasts to Evaluate Alternative Improvements, Impacts of New Development on Transportation Facilities. Master plans, Selection of Corridor, Corridor Identification, Corridor deficiency Analysis

Metropolitan cities: Design issues in urban mobility, integrating land use and transport planning; , Overview of urbanization process, city structure and urban activity and infrastructure systems,

Economic and social significance of urban infrastructure systems; Transport's Role in tackling Social Inclusion, Economic Impacts of Transport Policy

Text book:

1. Introduction to Transportation Planning – M.J.Bruton; Hutchinson of London Ltd.

Reference books:

1. Introduction to Urban System Planning - B.G.Hutchinson; Mc Graw Hill.

2. Traffic Engineering and Transport Planning - Kadiyali L.R., Khanna Publishers

3. Lecture notes on UTP - Prof. S. Raghavachari , R.E.C.Warangal.

4. Metropolitan transportation planning – John W. Dickey, Tata Mc Graw Hill, New Delhi,1975.

Course Outcomes:

- Ability to understand the needs for planning of Urban transportation systems.
- Ability to collect the data for planning.
- Ability to develop models for travel demand.
- Ability to plan for sustainable urban mobility.

RURAL ROADS :(4-0-0) CR-04

Course Objectives:

- To learn the concept of planning and alignment of rural roads.
- To learn about materials used for construction in rural roads.
- To learn about design and construction of rural roads.
- To learn about use of waste materials in pavement construction.

Module-I (10 Hours):

Planning and Alignment: Planning of Rural Roads, Concept of Network planning, rural roads planning, road alignment and surveys, governing factors on route selection, factors considered for alignment.

Module-II (10 Hours):

Materials and Pavement Design: introduction, Soil ,material surveys, embankment and sub-grade materials, stabilized Soils, Road aggregates, aggregate for base courses, new materials as stabilizers, materials for desert areas, materials for bituminous constructions and surfacing; materials for rigid pavements, special pavement, climatic suitability of concrete materials. Introduction, design procedure, pavement components, design of flexible and rigid pavements, special pavements design, types of drainage, and general criteria for road drainage, system of drainage, surface and subsurface systems.

Module-III (10 Hours):

Construction and Specifications: introduction, selection of materials and Methodology, Embankment and sub-grade, sub – base (granular), base(granular), shoulder, bituminous concrete, semi- rigid pavements, construction, concrete pavements, construction of special pavements, equipment required for different procedures.

Module-IV (10 Hours):

Waste material for pavement construction: introduction, fly ash for road construction, design & construction, design &construction of fly ash embankment lime fly ash and stabilized soil, lime fly ash pavements, control of compaction, concrete stabilized fly ash with admixtures.

Quality Control in Construction and Maintenance: Introduction, Pre-requirements, organizational setup, specification and code of practice, Laboratory equipment, Earth and granular layers, bituminous courses, semi- rigid and rigid pavements, special requirements, recovered of quality control data. Distresses/Defects in rigid and flexible pavements, Maintenance and evaluation, inventory roads and inspections, types of Maintenance Activities, Maintenance

Reference books:

1. IRC manual for rural roads. Special publication – 20(2002)

2. HMSO, Soil Mechanics for rural Engineers in, London

3. IRC related code books

4. NRRDA – guidelines and code books M-Tech (Transportation Engg.)

Course Outcomes:

- Ability to align rural roads.
- Ability to characterise the materials.
- Ability to design and construct rural roads.
- Ability to use of waste materials in pavement construction.

TRANSPORTATION SYSTEM MANAGEMENT:(4-0-0) CR-04

Course Objectives:

- To learn the philosophy of TSM.
- To learn about various types of mass transit.
- To learn about bus transit service.
- To learn about pedestrian and bicycle facilities.

Module-I (10 Hours):

TSM philosophy: System approach to Transportation Planning; Long Term Strategies and Short Term Measures; TSM actions- Objectives and Philosophy; Relevance of TSM actions in Indian Urban context. Board Spectrum of TSM actions.

Module-II (10 Hours):

Measures to promote transit: Preferential Treatment to high Occupancy Vehicles; Car Pooling; Transit Service Improvement Measures; Transit Management Improvement Measure; Transit and Para transit integration; Para Transit Role in urban areas; Multi-Modal Coordination.

Module-III (10 Hours):

Bus Route Network Planning and Management: Type of Bus Route Networks; Suitability for a given Urban Area; Types of routes – Corridor routes, activity routes and residential routes; issues in route networks evaluation – number of route, length of route; route alignment methods; service coverage and accessibility index.

Module-IV (10 Hours):

Promotion of Non – Auto modes: Measures to promote non-auto modes; Pedestrianization; Bicycle Transportation - advantages; Planning Bicycle Facilities - class I, Class II and Class III bikeways; Junction Treats for cycle tracks; LOS criteria for Pedestrian and bicycle Facilities.

Advanced Transit Technologies: Conventional and Unconventional Systems; Rapid Transportation System; New technologies – LRT, monorail, Automated Highways- Hovercraft; System Characteristics and Suitability.

Text book:

1. Metropolitan Transportation Planning, John W Dickey, Tata McGraw Hill

Reference books:

2. The Bicycle Planning, Mike Hudson, Open Books, UK

Course Outcomes:

- Ability to understand the philosophy of TSM.
- Ability to characterise various types of mass transit.
- Ability to develop a bus transit service.
- Ability to provide facilities for pedestrian and bicycle users.

TRANSPORTATION SAFETY & ENVIRONMENT :(4-0-0) CR-04

Course Objectives:

- To study the road accident.
- To learn about road safety measures.
- To learn about road safety audit.
- To study evaluation of road safety measures.

Module-I (10 Hours):

Trends in roads and highways development. Problem of road accidents in India. Characteristics of road accidents. Causes of accidents. Global and Indian road safety scenario. Factors responsible for success stories in road safety. Role of highway professionals in highway safety.

Module-II (10 Hours):

Planning of roads for safety. Land use planning and zoning. Development control and encroachment. Network hierarchy. Route planning through communities. Access control. Traffic segregation. Traffic calming designing for safety: road link design, alignment design. Cross-sectional elements. Traffic control devices. Road side safety. Road side facilities. Some critical elements. Junction design Basic principles. Selection of junction type. Factors affecting safety at various junction types. Elements to improve road safety. Provisions for vulnerable road users.

Module-III (10 Hours):

Road safety audit. Concepts of road safety audit, Road safety auditors & key personnel in RSA. Organizing and conducting a road safety audit. Example and commonly identified. Issues during RSA, Road safety audit report. Development of cost-effective of road safety audit accident investigation and prevention. Basic strategies for accident reduction. Significance of accident data. Accident investigation and identification of potential sites for treatment. Problem diagnosis. Selection of countermeasures. Example of selection of counter measures. Detailed design and implementation of counter measures.

Module-IV (10 Hours):

Monitoring and evaluation non-engineering measures for road safety, behavioral counter measures, education. Training and publicity. The goal of police traffic control activities. Strategy for road safety management by police. Role of NGOs in road safety. Legal framework for road safety transport related pollution, noise pollution, air pollution, effects of weather conditions, vehicular emission parameters, pollution standards. EIA requirements of highway projects, World Bank guidelines, EIA practices in India. Fuel crisis and transportation, factors affecting fuel consumption, fuel economy in various modes of transportation, various types of alternative fuels.

Text book:

1. Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.

Reference book:

1. Highway Engg. By S.K.Khanna& C.E.G. Justo, Nem Chand Bros., Roorkee.

Course Outcomes:

- Ability to study the road accident.

- Ability to develop road safety measures.
- Ability to audit road safety.
- Ability to evaluate road safety measures.

PUBLIC TRANSPORTATION :(4-0-0) CR-04

Course Objectives:

- To study the role of public transportation.
- To learn operation of various transit systems.
- To learn about public transportations systems.
- To study planning for public transport.

Module-I (10 Hours):

Modes of public transportation and application of each to urban travel needs.

Module-II (10 Hours):

Transit system operations, Para-transit systems, street transit systems, rapid transit systems, estimation of transit demand. Route development, properties of a good route set, determination of a good route set, stop location and stopping policy, schedule development, properties of a good schedule, determination of a good schedule.

Module-III (10 Hours):

Capacity of rapid transit systems, line capacity of RTS, capacity of street transit systems. Transit corridor, identification and planning, mass transport management measures, integration of public transportation modes. Public transport infrastructure, case studies, multi mode transportation system.

Module-IV (10 Hours):

Planning for public transport, fares and subsidies. Intermediate public transport in Indian cities, types of IPT vehicles. Characteristics of IPT modes.

Text book:

1. Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India

Reference books:

1. Introduction to Transport Planning by Bruton, M.J., Hutchinson Technical Education, London.
2. Traffic Engg. And Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.

Course Outcomes:

- Ability to plan public transport.
- Ability to operate various transit systems.

HIGHWAY PROJECT FORMULATION & ECONOMICS :(4-0-0) CR-04

Course Objectives:

- To learn about project formulation.
- To learn about various methods of economic evaluation.
- To learn about economic evaluation of the proposed alternatives.
- To learn about various aspects for project appraisal.

Module-I (10 Hours):

Project Formulation: Project Preparation – Flow Chart for Project preparation. Project Cycle- Project Formulation – Need and Scope of Project Formulation - Various Aspects and Approaches in Project Formulation. Stages in Project Formulation. Preparation of Feasibility Report and DPR – Guidelines.

Module-II (10 Hours):

Economic Evaluation : Need for Economic Evaluation; Stages involved in Economic Analysis; Cost and Benefit components; Discounting Criteria; Welfare economics; Social costs; Rate of Return; Road User Cost study in India ; Value of Travel time Savings - Economic concept of evaluation of travel time savings; Issues connected with evaluation of travel time savings. Vehicle operating costs - Components of VOC, Accident costs; Methodologies for economic evaluation of an accident.

Module-III (10 Hours):

Economic Analysis; Basic Concepts of Economic Analysis, Principles of Economic Analysis; Cash flow diagrams; Time value of Money; Development of cash flow Diagrams; Methods of Economic Evaluation -Equivalent Uniform Annual Cost Method; Present worth of cost method;- Equivalent uniform annual net return method; Net present value method; Benefit cost ratio method; Rate of Return Method. Applications of these methods to highway projects.

Module-IV (10 Hours):

Project appraisal by shadow pricing with case studies; Toll system analysis, financial analysis; Budgeting. Environmental impact assessment: Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety and Capacity Impacts – Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical case studies

Text book:

1. Traffic Engineering and Transport Planning - L.R Kadiyali, Khanna Publishers.

Reference books:

1. Transportation Engineering Economics - Heggie. I. G.; Mc Graw Hill Publishers.

2. Economic Analysis for Highways - Winfrey.R; International TextBook Company.

3. Road User Cost Study, CRRI

4. Road Project Appraisal, for Developing Countries, J.W.Dickey, John Wiley & Sons.

5. IRC: SP: 19; 2001, Manual For Survey, Investigation & Preparation of Road Projects.

6. IRC: SP: 30, Manual on Economic Evaluation of Highway Projects in India.

Course Outcomes:

- Ability to formulate a project.
- Ability to evaluate the alternatives of the project.
- Ability to study the various impacts of the project.

TRANSPORTATION ENGINEERING LAB :(0-0-6) CR-04

Course Objectives:

- To test the road aggregates.
- To test the paving grade bitumen.
- To test the Sub-grade Soil.
- To test the bituminous mix.

Tests on Aggregate

Aggregate Crushing value Test, Ten percent fine value Test, Blending of aggregate, Aggregate Impact value Test, Angularity no, specific gravity & bulk density of aggregate Test, Stripping value of aggregate Test

Tests on Bitumen

Bitumen content by centrifugal extractor apparatus Test, Ductility Test, Softening point Test, Penetration value and grade of bitumen Test, Specific gravity Test

Test on Sub-grade Soil

CBR Test, CBR test by dynamic cone penetrometer, North Dakota cone Test

Test on bituminous mix

Marshall Stability Test

Manual:

1. Highway Materials testing– S.K. Khanna & C.E.G. Justo. Nem Chand & Brothers.

Course Outcomes:

- Ability to characterise the road aggregates.
- Ability to characterise the paving grade bitumen.
- Ability to characterise the Sub-grade Soil.

- Ability to characterise the bituminous mix.

M. Tech – I year, II Sem. (Transportation Engineering)

TRAFFIC ANALYSIS :(4-0-0) CR-04

Course Objectives:

- To learn about traffic stream characteristics.
- To learn about various traffic stream models.
- To learn about traffic queuing analysis.
- To learn about pedestrian characteristics.

Module-I (10 Hours):

Traffic Flow Description: Traffic Stream Characteristics and Description Using Distributions: 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.

Module-II (10 Hours):

Traffic Stream Models: Fundamental Equation of Traffic Flow, Speed-Flow-Concentration Relationships, Normalized Relationship, Fluid Flow Analogy Approach, Shock Wave Theory - Flow Density diagram use in Shockwave analysis; Use of Time-space diagram for shockwave description; Bottleneck situations and shockwaves; traffic signal and shockwave theory; numerical Examples for application of shockwave theory; Car-Following Theory.

Module-III (10 Hours):

Queuing Analysis: Fundamentals of Queuing Theory, Demand Service Characteristics, Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Analysis of M/M/1 system; Assumptions and Derivation of System State Equations; Application of M/M/1 analysis for parking Garages and Toll Plazas- numerical Examples; Analysis of D/D/1 system for delay characteristics; Traffic Signal analysis as D/D/1 system; Computation of delays and queue dissipation Time – Numerical Examples.

Module-IV (10 Hours):

Pedestrian Delays And Gaps: Pedestrian Gap acceptance and delays; Concept of Blocks, Anti-blocks, Gaps and Non-Gaps; Underwood's analysis for Pedestrian Delays; Warrants for Pedestrian Crossing Facilities – Minimum Vehicular Volume Warrant, Minimum Pedestrian Volume Warrant, Maximum Pedestrian Volume Warrant; Simulation of Traffic: Introduction, Advantages of Simulation techniques, Steps in Simulation, Scanning techniques, Example of Simulation.

Text book:

1. Traffic Flow Theory: A Monograph, TRB Special Report 165

Reference books:

1. Traffic Flow Theory: A Monograph, TRB Special Report 165

2. Fundamentals of Transportation Engineering – C.S.Papacostas, Prentice Hall India Publication

3. Principles of Highway Engineering and Traffic Analysis – F.L.Mannering & W.P.Kilareski, John Wiley Publishers.

4. Traffic Flow Fundamentals – A.D.May, Prentice Hall India Publication

5. Fundamentals of Traffic Engineering – McShane & Rogers, 1977.

Course Outcomes:

- Ability to characterise the traffic stream.
- Ability to develop various traffic stream models.
- Ability to model traffic queue.
- Ability to characterise pedestrian.

Highway Construction Practice :(4-0-0) CR-04

Course Objectives:

- To learn about subgrade preparation.
- To learn about GSB, various types of unbounded base course.
- To learn about various types of bituminous construction.
- To learn about concrete road construction.

Module-I (10 Hours):

Embankment Construction: Formation cutting in Soil and hard rock, Preparation of Sub grade, Ground improvement, Retaining and Breast walls on hill roads,

Module-II (10 Hours):

Granular and Stabilized, Sub – bases / bases, Water Bound Macadam (WBM), Wet Mix Macadam (WMM), Cement treated bases, Dry Lean Concrete (DLC).

Module-III (10 Hours):

Bituminous Constructions: Types of Bituminous Constructions, Interface Treatments, Bituminous Surfacing and wearing Courses for roads and bridge deck slabs, Selection of wearing Course under different Climatic and Traffic conditions, IRC specifications,

Construction techniques and Quality Control.

Module-IV (10 Hours):

Concrete road construction: Test on Concrete mixes, Construction equipments, Method of construction of joints in concrete pavements, Quality Control in Construction of Concrete pavements, Overlay Construction. Hill Roads Construction: Stability of Slopes, Landslides – Causes and Control measures, Construction of Bituminous and Cement Concrete roads at high altitudes, Hill road drainage, Construction and maintenance problems and remedial measures.

Text book:

1. Principles & practice of Highway Engg.-Dr. L. R. Kadiyali & Dr. N. B. Lal - Khanna Publishers

Reference books:

1. IRC Codes

Course Outcomes:

- Ability to prepare road subgrade.
- Ability to construct GSB, various types of unbounded base course.
- Ability to construct various types of binder courses.
- Ability to construct concrete road.

PAVEMENT ANALYSIS AND DESIGN :(4-0-0) CR-04

Course Objectives:

- To learn about various factors affecting pavement design.
- To learn about stress analysis of the pavement.
- To learn about various methods of flexible pavement design.
- To learn about various methods of rigid pavement design.

Module-I (10 Hours):

Factors Affecting Pavement Design: Design life, reliability, traffic, climate, road geometry, material properties, and drainage.

Module-II (10 Hours):

Stresses In flexible Pavement: Vehicle-Pavement Interaction: Transient, Random & Damping Vibrations, Steady State of Vibration, Experiments on Vibration, Stress Inducing Factors in Flexible and Rigid pavements; Stress In Flexible Pavements: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two and Three Layered Systems, Fundamental Design Concepts.

Module-III (10 Hours):

Stresses in Rigid Pavements: Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses, and Stresses in Dowel Bars & Tie Bars.

Module-IV (10 Hours):

Design of Flexible Pavements: Factors effecting Design. Deflection studies in Flexible Pavements. Present Serviceability Index. IRC guidelines for Flexible Pavements. Pavement Performance and methods- AASHTO and Asphalt Institute Method. Need for Overlays, Overlays design methods for Flexible and Rigid pavements. Design of Rigid Pavements: Factors affecting Design - Wheel load & its repetition, sub grade strength & proportion, strength of concrete- modulus of elasticity. Reinforcement in slab. Design of joints. Design of Dowel bars. Design of Tie bars. IRC and AASHTO methods of Rigid Pavement design.

Text book:

1. Pavement Analysis & Design, Yang H. Huang, Prentice Hall Inc.

Reference books:

1. Design of Functional Pavements, Nai C. Yang, McGraw Hill Publications

2. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers

3. Principles of Pavement Design, Yoder.J. & Witzorac Mathew, W. John Wiley & Sons Inc

4. Pavement and Surfacing for Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.

5. IRC: 37 & 58 Codes for Flexible and Rigid Pavements Design.

Course Outcomes:

- Ability to analyse the stresses in the pavement.
- Ability to design flexible pavement by various methods.
- Ability to design rigid pavement by various methods.

ELECTIVES- III & IV

INTELLIGENT TRANSPORT SYSTEMS :(4-0-0) CR-04

Course Objectives:

- To learn about basics of ITS.
- To learn about data collection and analysis for ITS.
- To learn about various types of ITS models and evaluation methods.
- To learn about applications of ITS for sustainable mobility.

Module-I (10 Hours):

Fundamentals of ITS: Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS.

Module-II (10 Hours):

Sensor technologies and Data requirements of ITS: Importance of telecommunications in the ITS. Information Management, Tr

affic Management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection.

Module-III (10 Hours):

ITS User Needs and Services and Functional areas – Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveller Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS). ITS Architecture – Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning.

Module-IV (10 Hours):

ITS applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications;

ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Text book:

1. Fundamentals of intelligent transportation systems planning By Mashrur A. Chowdhury, Adel Wadid Sadek

Reference books:

1. Sensor technologies and Data requirements of ITS, Lawrence A. Klein

2. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

3. Perspective on ITS, Artech House Publishers, Sussman, J. M.

Course Outcomes:

- Ability to collect data and analyse for ITS.
- Ability to develop ITS models.
- Ability to apply ITS for sustainable mobility.

PAVEMENT CONSTRUCTION MAINTENANCE AND MANAGEMENT :(4-0-0) CR-04

Course Objectives:

- To learn about basics of PMS.
- To learn about evaluation (functional and structural) of existing pavement.
- To learn about construction and maintenance of pavement (flexible and rigid).

Module-I (10 Hours):

Pavement management system: Components of PMS and their activities; Major steps in implementing PMS; Inputs; Design, Construction and Maintenance; Rehabilitation and Feedback systems; Examples of HDM and RTIM packages; Highway financing; Fund generation; Evaluating alternate strategies and Decision criteria ; Pavement Maintenance Management Components of Maintenance Management and Related Activities – Network and Project Level Analysis; Prioritization Techniques and Formulation of Maintenance Strategies.

Module-II (10 Hours):

Pavement Inventories, Quality Control and Evaluation Serviceability Concepts ;Visual Rating ;Pavement Serviceability Index; Roughness Measurements ;Distress Modes – Cracking Rutting Etc; Pavement Deflection – Different Methods and BBD, Skid Resistance, Roughness, Safety – Aspects; Inventory System. Causes of Deterioration, Traffic and Environmental Factors, Pavement

Performance Modelling Approaches and Methods of Maintaining WBM, Bitumen and Cement Concrete Roads, Quality Assurance; Quality Control – ISO:9000 , Sampling Techniques – Tolerances and Controls related to Profile and Compaction

Module-III (10 Hours):

Construction of Base, Sub base, Shoulders and Drain Roadway and Drain Excavation, Excavation and Blasting, Embankment Construction, Construction of Gravel Base, Cement Stabilised Sub- Bases, WBM Bases, Wet Mix Construction; Crushed Cement Bases, Shoulder Construction; Drainage Surface, Turfing, Sand Drains; Sand Wicks; Rope Drains, Geo- Textile Drainage; Preloading Techniques

Module-IV (10 Hours):

Bituminous Construction and Maintenance: Preparation and Laying of Tack Coat; Bituminous Macadam ,Penetration Macadam, Built up Spray Grout, Open Graded Premix, Mix Seal, Semi-Dense Asphalt Concrete-Interface Treatments and Overlay Construction, IRC Specifications, Cement Concrete pavement Construction and Maintenance: Cement Concrete Pavement Analysis - Construction of Cement Roads, Manual and Mechanical Methods, Joints in Concrete and Reinforced Concrete Pavement and Overlay Construction.

Text book:

1. Pavement management systems – Haas and Hudson, W. R.-McGraw Hill publications

Reference books:

1. Pavements and surfacing for highways and airports – Sargious, M. A. – Applied Science Publishers ltd

2. Bridge and Pavement maintenance- Transportation Research Record no.800, TRB

3. Pavement management for airports, roads and parking lots- Shahin M.Y

4. Highway and Traffic engineering for developing countries-Bent Thagesan

5. MORTH - Specifications

Course Outcomes:

- Ability to evaluate (functional and structural) existing pavement.
- Ability to maintain the pavement (flexible and rigid).

OPTIMIZATION TECHNIQUES :(4-0-0) CR-04

Course Objectives:

- To learn about linear programming.
- To learn about non linear programming.

- To learn various search methods.
- To learn about dynamic programming.

Module-I (10 Hours):

Linear Programming: Introduction and formulation of models; Convexity; simplex method; Two phase method; Degeneracy, non - existent and unbounded solutions; Duality in L.P.P. Dual simplex method, Sensitivity analysis; Revised simplex method; transportation and assignment problems.

Module-II (10 Hours):

Non-Linear Programming: Classical optimisation methods; Equality and inequality constraints; Lagrange multipliers; & KuhnTucker conditions; Quadratic forms; Quadratic programming.

Module-III (10 Hours):

Search Methods: One dimensional optimisation; Fibonacci search; multi dimensional search methods; Univariate search; gradient methods; steepest descent/ascent methods; Conjugate Gradient method; Penalty function approach.

Module-IV (10 Hours):

Dynamic Programming: Principle of optimality; Recursive relations; solution of L.P.Problem; simple examples. Integer Linear Programming: travelling salesman problem

Text book:
1. Optimisation Theory and Applications - S.S.Rao; Wiley Eastern Ltd., New Delhi

Reference Books:
1. Introduction to Optimisation - J.C.Pant; Jain Brothers; New Delhi.

2. Optimisation Method - K.V.Mital; Wiley Eastern Ltd. New Delhi.

Course Outcomes:

- Ability to apply linear programming.
- Ability to apply non linear programming.
- Ability to apply search methods.
- Ability to apply dynamic programming.

GIS APPLICATIONS IN TRANSPORTATION ENGINEERING :(4-0-0) CR-04

Course Objectives:

- To learn about basics of GIS.
- To learn about Geographic Data collection.

- To learn about GIS Data Processing, Analysis and Modelling.
- To learn about application of GIS in Transportation Engineering.

Module-I (10 Hours):

Introduction: Definitions of GIS – Components of GIS – Geographic data presentation: maps – mapping process – coordinate systems – transformations – map projections – geo referencing - data acquisition.

Module-II (10 Hours):

Geographic Data Representation, Storage, Quality and Standards: Storage - Digital representation of data –Data structures and database management systems – Raster data representation – Vector data representation –Concepts and definitions of data quality – Components of data quality – Assessment of data quality –Managing data errors – Geographic data standards.

Module-III (10 Hours):

GIS Data Processing, Analysis and Modelling: 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 modelling – DTM; Data Management: The data base designs and approaches, 3 classic data models, Nature of geographic data, Spatial data models, Databases for GIS ; Implementation and Maintenance of GIS, Evaluation of alternative systems, System justification and Development of an implementation plan

Module-IV (10 Hours):

Application of GIS in Transportation Engineering – I : Intelligent information system for road accessibility study, GIS data base design for physical facility planning, Decision support systems for land use planning.

Application of GIS in Transportation Engineering – II: GIS applications in environment impact assessment and environment monitoring, GIS based Highway alignment, GIS based road network planning, and GIS based traffic congestion analysis and accident investigation, Utility management.

Text book:

1. Principles of Geographical Information Systems, Burrough, P.A., Oxford Publication

Reference books:

1. Concepts and Techniques of Geographic Information Systems, Lo, C.P. & Yeung A.K.W., Prentice Hall of India, New Delhi.

2. Getting Started with Geographic Information Systems, Clarke, K., Prentice Hall, New Jersy.

3. Fundamentals of Geographic Information Systems, DeMers, M.N., John Wiley & Sons, New York.

4. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England).

5. Geographical Information System – An Introduction, Jeffrey, S. & John E., Prentice-Hall.

6. Basic Readings in Geographic Information Systems, Marble, D.F., Galkhs HW & Pequest, Sped System Ltd., New York.

7. GIS for Urban & Regional Planning, Scholten & Stillwen, Kulwer Academie Publisher.

8. GIS A Management, Perspenfi Stan Aronoff, and WDL Publisher.

Course Outcomes:

- Ability to collect Geographic Data.
- Ability to process and analyse GIS data.
- Ability to develop Model.
- Exposure to application of GIS in Transportation Engineering.

ENVIRONMENTAL IMPACT ASSESSMENT :(4-0-0) CR-04

Course Objectives:

- To learn about the importance of Environmental Impact Assessment.
- To understand the methods followed for the impact assessment.

Module-I (10 Hours):

National environmental policy act and its implementation: Terminology, Features of the National Environmental Policy Act, Screening in the EIA Process, Summary Statistical Information on EISs, EIA at the International Level, Utility of the EIA process, Expanded scope of EIA, Narrowed scope of EIA

Planning and management of impact studies: Conceptual Approach for Environmental Impact Studies, Proposal Development, Interdisciplinary Team Formations, Team Leader Selection and Duties, General Study Management, Fiscal Control

Module-II (10 Hours):

Simple method for impact identification: Background Information, Interaction Matrix Methodologies, Network Methodologies, Checklist Methodologies

Description of environmental setting: Conceptual Framework, Initial List of Factors, Selection Process, Documentation of Selection Process, Data Sources

Environmental indices and indicators: Background Information, Environmental-Media Index-Air Quality, Environmental-Media Index—Water Quality, Environmental-Media Index—Noise

Module-III (10 Hours):

Prediction and assessment of impacts on the Air environment: Basic Information on Air Quality Issues, Conceptual Approach for Addressing Air Environment Impacts

Prediction and assessment of impacts on the Surface-water environment: Basic Information on Surface-water Quantity and Quality, Key Federal Legislation, Conceptual Approach for Addressing Surface-Water –Environment Impacts

Prediction and assessment of impacts on the soil and ground-water environments: Background Information on the soil Environment, Background Information on Groundwater Quantity and Quality, Key Federal Legislation, Conceptual Approach for Addressing Soil and Groundwater-Environment Impacts

Module-IV (10 Hours):

Prediction and assessment of impacts on the noise environment: Basic Information on Noise, Key federal Legislation and Guidelines, Conceptual Approach for Addressing Noise-Environment Impacts

Prediction and assessment of impacts on the biological Environment: Basic Information on Biological Systems, Key Federal Legislation, Conceptual Approach for Addressing Biological Impacts

Environmental laws and policies – Environmental laws for managing Air, water, land, wastewater, solid waste, hazardous waste, natural resources

Reference books:

1. Canter L., (1995), "Environmental Impact Assessment", McGraw Hill.
2. Jain R.K., Urban L.V., Stacey G.S., (1977), "Environmental Impact Analysis – A New Dimension in
Decision Making", Van Nostrand Reinhold Co.
3. Rau and Wooten, (1981), "Environmental Impact Assessment Handbook". McGraw Hill.
4. Environmental Law, Sengar, PHI.

Course Outcomes:

- Ability to make decision based on the environmental consequences of proposed actions.
- Ability to promote environmentally sound and sustainable development by identifying appropriate measures.

CONCRETE TECHNOLOGY :(4-0-0) CR-04

Course Objectives:

- To understand the properties of ingredients of concrete.
- To study the behaviour of concrete at its fresh and hardened state.
- To study about the concrete design mix.
- To know about the procedures in concreting.
- To understand special concrete and their use

Module-I (10 Hours):

Introduction of concrete, Historic development, Composition of concrete, Advantages of concrete over other materials, Advances and future trends in concrete, Overview of Sustainability and Concrete development.
Cement: Production, composition, and properties; cement chemistry, Types of cements; special cements; Aggregates: Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates; Water: General requirements & limiting values of impurities

Module-II (10 Hours):

Admixtures: Water reducers, air entertainers, set controllers, special admixtures - structure properties and effects on concrete properties; Introduction to supplementary cementing materials and pozzolans; Other mineral additives - reactive and inert.

Concrete mix design**:** Basic principles; IS method; ACI method; new approaches based on rheology and particle packing.

Module-III (10 Hours):

Concrete Production & Fresh concrete**:** Batching of ingredients; mixing, transport, and placement; Consolidation, finishing, and curing of concrete; initial and final set - significance and measurement; Workability of concrete and its measurement.
Engineering properties of concrete**:** Compressive strength and parameters affecting it; Tensile strength -direct and indirect; Modulus of elasticity and Poisson's ratio; Stress strain response of concrete.
Dimensional stability and durability: Introduction to durability; relation between durability and permeability; Chemical attack of concrete; corrosion of steel rebars; other durability issues**;** Creep and relaxation - parameters affecting; Shrinkage of concrete - types and significance; Parameters affecting shrinkage; measurement of creep and shrinkage**.**

Module-IV (10 Hours):

Non-Destructive testing of concrete: Introduction to Destructive, semi -destructive & Non-destructive testing methodology, Problems faced during Non-destructive evaluation, Test methods like Rebound Hammer test, Ultra-sonic pulse velocity, Penetration tests, Pull out test
Special concretes**:** Properties and applications of: High strength - high performance concrete, reactive powder concrete; Lightweight, heavyweight, and mass concrete; fibre reinforced concrete; self-compacting concrete; shotcrete; other special concretes.
Overview of Fracture Mechanics: Origin of fracture mechanics, Understanding the quassi-brittle nature of concrete, Failure of concrete under low stress, Micro-cracking, crack propagation, stress concentration at openings.

Text books:

1. A. M. Neville, Concrete Technology (English) 1st Edition; Pearson India publications.

2. M.L. Gambhir, Concrete Technology, 5th Edition; by; McGraw Hill Education (India) Private Limited.

Reference books:

1 P. Kumar Mehta, and Paulo J.M. Monteiro; Concrete: microstructure properties and materials: Tata McGraw Hill Education Private Limited

2. M S Shetty, Concrete Technology: Theory and Practice; 7th Edition;; S. Chand & Company Ltd-New Delhi.

Course Outcomes:

- Ability to test all the concrete materials as per IS code.
- Ability to design the concrete mix using ACI and IS code methods.
- Ability to determine the properties of fresh and hardened of concrete design special concretes and their specific applications.
- Ensure quality control while testing/ sampling and acceptance criteria

BRIDGE ENGINEERING :(4-0-0) CR-04

Course Objectives:

- To understand various stages of bridge planning
- To understand various types of IRC loadings
- To analyze cables and suspension bridges subjected to IRC loadings
- To study the design of various types bridge and culverts

Module-I (10 Hours):

Introduction: classification and components of a standard bridge, Engineering and aesthetic requirements, introduction to bridge codes.
Investigation for bridge: Site selection, data drawing, design discharge linear water way, economical span, location of piers and abutments, vertical clearance above HFL, scour depth and choice of bridge type.
Standard Loadings for Road Bridges: Dead load, Live loads, Impact effect, Wind load, Longitudinal forces, Centrifugal forces, Horizontal forces due to water current, Buoyancy effect, Earth pressure, Deformation stresses, Erection stresses, Temperature effects, and Seismic force.

Module-II (10 Hours):

Foundation and substructures: Types of foundation (open, pile, well and caisson), design of piers, abutments, wing wall and bed blocks.
Design of Culverts: Design of Pipe culverts (hydraulics and structural), Analysis and design of right, skew and curved slab culvert; design of single vent rectangular box culvert.

Module-III (10 Hours):

Design of Girders: Design and detailing T-beam bridge (without footpath), load distribution, design and orthographic plate analysis of bridge deck.
Bearings: Bearings for slab bridges and girder bridges, design of elastomeric bearing.
Joints: Design and construction of expansion joints.

Module-IV (10 Hours):

Introduction to long span bridges: Cantilever bridges, Arch bridges, Cable stayed bridges, suspension bridges, Pre-stressed concrete bridge (pre-tensioned and post-tensioned) and steel bridges.
Bridge Launching: Methods of erection of concrete, steel, pre-stressed and composite bridges
Inspection and Maintenance of Bridges: Types of inspection (routine inspection, principal inspection and special inspection), Types of maintenance (Ordinary maintenance and specialized maintenance).

Text book:

1. Essentials of Bridge Engineering, by DJ Victor, Oxford IBH.

Reference books:

1. Design of Bridge Structures, by T. R. Jagadeesh, PHI.

2. Principles and Practice of Bridge Engineering, SP Bindra, Dhanpat Rai Publications

Course outcomes:

- Ability to design the slab culvert, Box culvert
- Ability to design the T beam bridge and substructures
- Ability to design the Bridge bearings
- Ability to design the steel bridge for railways

PLANNING & DESIGN OF AIRPORTS :(4-0-0) CR-04

Course Objectives:

- To learn about airport planning.
- To learn about geometric design of runways.
- To learn about geometric design of various structural components of airport.
- To learn about airport visual aids.

Module-I (10 Hours):

Classification of airports: ICAO standards. Planning for airport, airport components, zoning laws.

Module-II (10 Hours):

Runways Orientation and Geometric Design: Runway patterns. Taxiways alignment geometry and turning radius exit taxiways.

Module-III (10 Hours):

Aprons Planning and Design: Design principles of critical, semi-critical, non-critical airport pavements, and FAA and PCA methods. Airport hangars, their planning and design criteria.

Module-IV (10 Hours):

Airport landscaping: Grading and drainage general aspects. Airport terminal and amenities. Airport lighting and marking.

Text book:

1. Planning and Design of Airports, Khanna, Arora and Jain, Nem Chand Bros

Reference books:

1. Airport Engineering, N.J. Ashford, P.H. Wright, John Wiley

2. Planning and Design of Airports, R.M. Horonjeff, F.X. McKelvey, W.J Sproule, Seth Young,

TMH International Publishers

3. Airport Planning & Management, Wells, Alexander; Young, Seth, McGraw Hill.

4. Airport Systems: Planning, Design, and Management, De N. Richard, & Odoni, McGraw Hill Amedeo.

Course Outcomes:

- Ability to plan an airport.
- Ability to design the geometric aspects of runways.
- Ability to design the geometric aspects of various structural components of airport.
- Ability to provide visual aids to an airport.

LAND USE TRANSPORTATION MODELLING :(4-0-0) CR-04

Course Objectives:

- To learn relation between land use and transportation.
- To learn about land use transportation model.
- To learn about travel demand model.
- To learn about Regional Network Planning.

Module-I (10 Hours):

Land Use and Transportation Engineering: Transportation Planning models; Models and their role, Characteristics of Transport demand and supply, Equilibrium of supply and demand, Modelling and decision making, Issues in Transportation modelling and structure of the classic transport model.

Module-II (10 Hours):

Land Use Transportation and Activity Models: Introduction to Land Use Planning; Relation between Transportation and Land Use Planning; The economic base mechanism and allocation mechanism; Spatial allocation and employment interrelationship; Garin Lowry models.; Activity modelling

Module-III (10 Hours):

General Travel Demand Models and Regional Transport Models: Aggregate, Disaggregate models ; Behavioural models; Recursive and direct demand Models; Linear, Non-Linear models; Logit, discriminant and probit models; Mode split models - Abstract mode and mode specific models. Regional Transport Models: Factors affecting goods and passenger traffic; Prediction of traffic; Growth factor models; Time function iteration models; internal volume forecasting models.

Module-IV (10 Hours):

Regional Network Planning: Problems in Developing Countries, Network Characteristics - Circuitry, Connectivity, Mobility, Accessibility and Level of Service Concepts - Network Structures and Indices – Network Planning – Evaluation - Graph Theory – Cut sets – Flows & Traversing – Optimum Network - Inter-modal Co-ordination. – Rural Road Network Planning.; User equilibrium concepts

Text book:

1. Modelling Transport by Jhan De Dios Ortuzar. Luis E.Willumsen. John Wiley& Sons

Reference books:

1. Urban Development Models - Ed. By R.Baxter, M.Echenique and J.Owers; The Institute of Transportation Engineering, University of California.

2. Economic Models and Economic Forecast - Robert S, Pindyek, Daniel L.Rubin Field; McGraw Hill.

3. Land Use Transportation Planning Notes - S.R.Chari, REC Warangal.

4. Regional and Urban Models- A.G.Wilson; Pion, London.

5. Urban Modelling - Michael Batty.

6. Introduction to Transportation Engineering and Planning, Morlok EK, McGraw Hill

Course Outcomes:

- Ability to understand relation between land use and transportation.
- Ability to develop land use transportation model.
- Ability to develop travel demand model.
- Ability to develop Regional Network Planning.

GROUND IMPROVEMENT TECHNIQUES :(4-0-0) CR-04

Course Objectives:

- To learn the basic principles of various ground improvement techniques
- To learn selection of the most appropriate ground improvement technique in specific circumstances
- To understand the design procedure of various ground improvement techniques
- To learn the observational method and instrumentation used in Geotechnical Engineering.
- To learn use of geo textiles and other synthetic materials for reinforcing soil..

Module-I (10 Hours):

Introduction, Necessity of ground improvement, Dewatering, methods, Analysis and design of dewatering systems. Grouting types, Properties, Method of grouting, Ground selection and control.

MODULE – II (10 Hours)

Compaction, Methods of compaction, engineering prosperities of compacted soil, Field compaction and its control.

MODULE – III (10 Hours)

Soil stabilization, Use of chemical additives, Stone columns, Principle, design and method of installation.

MODULE – IV (10 Hours)

Reinforced earth, Concept, Materials, Application and design, Use of geo-synthetics and geo-cells in construction work.

Text books:

1. Ground Improvement Technique, P. Purusothom Raj

Reference Book

1. Foundation Design and Construction, M.J. Tomlinson

2. Foundation Engineering, G.A. Leonard, Tata McGraw Hill

3. Modern Geotechnical Engineering, Alam Singh, IBT Publishers

Course Outcomes:

- Ability to apply the ground improvement technique using admixture and advanced technique using grouting.
- Ability to identify the relevance of reinforcing elements to resist the lateral earth pressures
- Ability to apply suitable techniques for the deep compaction of granular soils and improvement of cohesive soils
- Ability to utilize ground anchors and soil nails for design of soil retained structures.

TRANSPORTATION ENGINEERING DESIGN: (0-0-6) CR-04

Course Objectives:

- To learn earthwork calculation.
- To learn about runway orientation.
- To learn about hydraulic design of culvert.
- To learn pavement design (flexible and rigid).
- To learn about traffic study

1. Earth work calculation of a road project 2. Mass haul diagram plotting for the earth work. 3. Runway orientation. 4. Hydrological design of a culvert. 5. Flexible pavement design. 7. Rigid pavement design. 8. Rural road design. 9. Traffic volume count. 10. Spot speed study. 11. Parking studies. 12. Design of a vertical curve. 13. Design of a track junction. 14. Videographic Survey 15. Benkle man beam study.

Course Outcomes:

- Ability to calculate earthwork.
- Ability to orient a runway.
- Ability to design (hydraulic) a culvert.
- Ability to design pavement (flexible and rigid).
- 5. Ability to conduct traffic survey.