DEPARTMENT OF CIVIL ENGINEERING

KALASALINGAM UNIVERSITY

(Kalasalingam Academy of Research and Education)

Anand Nagar, Krishnankoil – 626 190.

INTRODUCTION OF A NEW COURSE

M.Tech. in TRANSPORTATION ENGINEERING AND MANAGEMENT

MAT5061	STATISTICAL METHODS AND QUEUING THEORY	L	T	P	C
		3	1	0	4

Course Outcomes:

At the end of the course, students would be able to

CO1 : Students will acquire knowledge in probability and random variables

CO2 : Students will understand the various estimation theories.

CO3: Students will know the estimation of parameters using maximum likelihood estimator and method of moments.

CO4: Students will understand the various queuing theories.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

UNIT I PROBABILITY AND RANDOM VARIABLES

Probability – Random variables – Binomial, poisson, geometric, uniform, normal, exponential distributions – Moments – Moments generating functions and their properties – Function of random variables.

UNIT II ESTIMATION THEORY

Partial and multiple correlations – Partial and multiple regressions – Estimation of parameters using maximum likelihood estimator and method of moments.

UNIT III TESTING OF HYPOTHESIS

Basic definitions of statistical hypothesis – Tests based on normal, t, chi-square and F distributions for mean, variance and proportion.

UNIT IV DESIGN OF EXPERIMENTS

Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design.

UNIT V QUEUING THEORY

Single and multiple servers - Markovian Queuing models – Customer impatience – Queuing applications.

REFERENCES

1. Gupta, S.C. and Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi (2001).

2. Taha, H.A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi (2002).

3. Walpole, R.E., Myer, R.H., Myer, S.L. and Ye, K., Probability and Statistics for Engineers and Scientists, 7th edition, Pearson Education, Delhi (2002).

4. Goel, B.S. and Mittal, S.K., Operations Research, Pragati Prakashan, Meerut (2000).

CIV 5201	TRANSPORTATION SYSTEMS PLANNING	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Understand the planning of transit system and network

CO2 : Apply various methods to perform survey for planning of transit system

CO3: Design the transit network by considering all important parameters

CO4: Analyze the capacity of transit system and level of service

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					H		M
CO2	M	M	M		H	H					M	H
CO3	M	M	M				H				H	
CO4	M	M	H					M			M	

UNIT I TRANSPORTATIONSYSTEMS

Systems Approach to Transport Planning – Interdependence of the Landuse and Traffic– Stages in Transportation Planning – Transport Planning Considerations Travel Forecasting Process – Statutory Land Use Planning Process – Planning Issues

UNIT II TRANSPORTATION INVENTORIES

Concepts of Zoning – Methods of Transportation Surveys – Inventory of Transport and other activities – Planning Studies and Methods – Development of Planning Process

UNIT III TRAVEL DEMAND FORECASTING

Trip generation – Trip classification – production and attractions – Multiple regression models – Category analysis – Trip production models – Trip distribution models – Linear programming approach

UNIT IV ROUTE AND MODE CHOICE MODELING

Model split models – Behavioral models – Probabilistic models – Utility functions – logit models – Two stage model. Traffic assignment – Assignment methods – Route-choice behaviour – Network analysis.

UNIT V LAND USE TRANSPORT MODEL (LUT)

Land use and its interaction – Lowry derivative models – Quick response techniques – Non-Transport solutions for transport problems. Characteristics of urban structure. Town planning concepts.

REFERENCES:

1. Jotin Khisty C, Kent Lall B, Transportation Engineering – An Introduction, Third Edition, Prentice Hall of India, New Delhi, 2002
2. Papacostas C.S., Prevedouros, Transportation Engineering and Planning, Third Edition, Prentice Hall of India, New Delhi, 2002
3. John D.Edwards (Edr.), Transportation Planning Hand Book, Second Edition, Institute of Transportation Engineers, Prentice Hall Inc., Washington DC, USA, 1999
4. John W Dicky, Metropolitan Transportation Planning – A Decision Oriented Approach, McGraw Hill, New York, 1984
5. O'Flaherty C.A, Transport Planning and Traffic Engineering, Elesevier Publications, New Delhi,1997

CIV 5202	PAVEMENT MATERIALS AND CONSTRUCTION	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Select appropriate earth moving and compaction equipment depending upon the requirement.

CO2 : Prepare quality assurance and quality control plans in an attempt to construct better performing pavements.

CO3: Evaluate the pavements based on the functional and structural characteristics.

CO4: Evaluate the safety aspects of the pavements specifically in terms of friction and other related distresses.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					H		M
CO2	M	H	M		H	H					M	H
CO3	M	M	H				M				H	
CO4	H	M	H					M			M	

UNIT I SUBGRADE

Functions and significance of subgrade properties – Methods of assessment of subgrade strength – Soil classification – Ground Improvement Techniques – Wheel loads – ESWL – EWLF

UNIT II MATERIALS FOR FLEXIBLE PAVEMENT

Bitumen – types and grades – properties and testing of materials used in granular layers and bituminous layers – Types of granular and bituminous mixes — mix design for granular materials – bituminous mix design - super pave concepts – new materials like polymer modified bitumen, geosynthetics etc.

UNIT III MATERIALS FOR RIGID PAVEMENT

Cement – grades – chemical composition – hydration of cement – testing – admixtures – fibres - properties and testing of pavement quality concrete – mix design – acceptance criteria

UNIT IV CONSTRUCTION PROCEDURES

Methods of construction and field control checks for various types of flexible pavement layers – recycling of bituminous materials
Cement concrete pavements – methods of construction of various layers – joints-quality control tests

UNIT V HIGHWAY CONSTRUCTION EQUIPMENTS

Excavators, graders, vibratory rollers, sensor pavers, computerized asphalt mix plant, plants and trucks for ready mix concrete, slip form paver – working principle, advantages and limitations

REFERENCES:

1. Specifications for Road and Bridge works, Fourth Revision, MoSRT&H(India), 2001
2. IRC 15 – 2002, Standard Specifications and Code of Practice for Construction of Concrete Roads
3. Peurify.R.L., Construction Planning, Equipment and Methods, McGraw Hill Publishers, New York, 2000
4. S.C.Sharma., Construction Equipment and its Management, Khanna Publishers, New Delhi, 1988
5. Asphalt Technology and Construction Practices, The Asphalt Institute, Maryland, USA, 1997

CIV 5203	TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Understand TSM, the need for TSM and the objectives of TSM.

CO2 : Understand the types of TSM strategies

CO3: Apply a strategy based on a TSM goal or objective

CO4: Recommend methods to manage a transit system to improve its management efficiency.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					H		M
CO2		H	M	H	H	H					M	H
CO3		M	H	M			M				H	
CO4		M	H	M		H		M			M	

UNIT I TRAFFIC CHARACTERISTICS

Elements of Traffic Engineering – road user, vehicle and road way. Vehicle characteristics – IRC standards – Design speed, volume. Highway capacity and levels of service – capacity of urban and rural roads – PCU concept and its limitations – Road user facilities – Parking facilities – Cycle tracks and cycle ways – Pedestrian facilities

UNIT II SURVEYS AND STUDIES IN TRAFFIC ENGINEERING

Conventional and Modern Methods of Traffic Survey and Studies – Volume and Capacity – Headway concepts and applications – Speed and Delay – Origin and Destination, Parking, Accident – Level of Services (LoS)

UNIT III GEOMETRIC DESIGN OF ROADS

Design of roads – Design Speed, Terrain, Gradient curves – Horizontal and Vertical, Superelevation, Sight Distance – Stopping Sight Distance, Overtaking Sight Distance, Design of Cycle Tracks, Pedestrian Facilities, Parking Facilities, Street Lighting

UNIT IV INTERSECTION DESIGN

Design of Intersection – At grade intersection – Uncontrolled, Channelisation, Rotary, Traffic Signal Control, Signal Co-ordination, Grade Separated Intersection Types and Design

UNIT V TRAFFIC OPERATION AND MANAGEMENT

Traffic Sign, Road Markings, Traffic Control Aids, Street furniture, Road Arboriculture - Traffic Regulation, Cost Effective Management Measures – Traffic Systems Management and Travel Demand Management - Congestion Management, Traffic Calming and Pricing

REFERENCES:

1. Wolfgang S.Homburger et.al., 'Fundamentals of Traffic Engineering' 15th Edition, Institute of Transportation Studies, University of California, Berkely, 2001
2. James L.Pline (Edr) 'Traffic Engineering Hand Book', Institute of Transportation Engineers, Washington DC, USA, 1999
3. Nicholas T.Garber, Lester A Hoel, 'Traffic and Highway Engineering', Revised Second Edition, ITP, California, USA, 1999
4. Thomas Curinan, 'An Introduction to Traffic Engineering – A Manual for Data Collection and Analysis', Books Cole, UK, 2001
5. Kadiyali, L.R., 'Traffic Engineering and Transport Planning', Khanna Publishers, Delhi, 2002

CIV 5105	PAVEMENT MATERIALS LAB	L	T	P	C
		0	0	6	2

Course Outcomes:

At the end of the course, students would be able to

CO1: Characterize the pavement materials including soil, aggregate, bitumen, and bituminous mixes in the laboratory.

CO2: Perform quality control tests on pavements and pavement materials. CO3: Measure the functional response characteristics of in-service pavements.

CO4: Measure the structural response characteristics of in-service pavements.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2						L					L	L
CO3	M		L		L						M	
CO4			H								M	

LIST OF EXERCISES

1. Tests on conventional bitumen, bitumen emulsion, cut back bitumen and modified bitumen.
2. Tests on road aggregates.
3. Tests on bituminous mixture.
4. Design of dense bituminous mixes.
5. Design of pavement quality concrete mix.

CIV 5204	COMPUTER MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Understand different optimisation techniques and simulation tools.

CO2: Solve linear, no-linear and dynamic programming problems.

CO3: Find feasible solution to transportation problems.

CO4: Develop micro simulation models.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

UNIT I SYSTEMS APPROACH

Introduction to system approach – Typical transportation system – Mathematical models. Fundamentals of simulation – Monte Carlo method – Analog and digital simulation – Continuous and discrete models – Simulation languages.

UNIT II MODEL CONCEPTUALISATION

Causal Loop (CL) Diagramming – Diagramming Approach – Justification for links – Conceptualisation and Development of Causal Loop Representations -Case Study examples in C.L diagramming in Transportation Planning.

UNIT III SYSTEM DYNAMICS MODELING

Principles of Systems and its Hierarchies – System Dynamic Model – Application to Transportation Infrastructure Planning – Sensitivity ad Dimensional Analysis – Validation of System Dynamics Model

UNIT IV TRANSPORTATION MODELING

Conventional Modeling – Computer Simulation Modeling efforts – Application of relevant softwares in Transportation Planning – Transportation Simulation - Transportation Assignment - GIS Application in Transportation Planning

UNIT V MODEL VALIDATION

Concepts of Model Verification – Testing – Sensitivity and Dimensional Analysis – Significance of Sensitivity Testing – Methods of Validation – S.D Model Validation and Calibration – Conventional Model Validation – Simulation Model Validation efforts

REFERENCES:

1. Pratab Mohapatra K.J.et al., Introduction to System Dynamics Modeling, University Press, Hyderabad,1994
2. Thirumurthy A.M., Environmental Facilities and Urban Development in India – A System Dynamics Model for Developing Countries, Academic Foundations, India,1992.
3. Nancy Roberts et al., Introduction to Computer Simulation – A System Dynamics Modeling Approach, Addison – Wesley, London,1983
4. Papacostas C.S., Prevedouros , Transportation Engineering and Planning, Third Edition, Prentice Hall of India, New Delhi,2002
5. John D.Edwards, Jr. P.E, Transportation Planning Handbook, Institute of Transportation Engineers, Prentice Hall Publication, Washington D.C., USA,1999

CIV 5205	THEORY OF TRAFFIC FLOW	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Gain insight into theory and modelling of traffic flow operations.

CO2: To apply theory and mathematical models to solve practical problems and to gain experience with using simulation programs.

CO3: The empirical relation between the flow variables and the bottleneck capacity analysis are discussed.

CO4: This course provides an overview of human factors relevant for the behaviour of drivers.

UNIT I TRAFFIC FLOW FUNDAMENTALS

Traffic stream parameters – Fundamental diagram of volume-speed-density surface. Discrete and continuous probability distributions. Merging maneuvers – critical gaps and their distribution.

UNIT II TRAFFIC DELAYS

Lighthill and Withams Theory – Application of theory to deal bottlenecks – Trajectory Diagrams – Shock waves – Propagation and equation – Gree burgs extension of law of continuity – Car Following theory

UNIT III TRAFFIC FLOW CHARACTERISTICS

Traffic Flow characterization – Categories of Traffic Flow – Macroscopic and Microscopic Traffic Flow Models – Centrally versus Individually controlled modes – Vehicular Stream Models

UNIT IV SIMULATION MODELS

Basics of simulation – Simulation Model and Classification – Simulation o Urban Traffic Flow Characteristics - Application of Computer Simulation in Traffic Flow Studies – Future Traffic Simulation Model

UNIT V QUEUING MODELS

Microscopic models – Application of queuing theory – regular, random and Erlang arrival and service time distributions – Waiting time in single channel queues and extension to multiple channels.

REFERENCES:

1.Drew, D.R., Traffic Flow Theory and Control, McGraw Hill, NewYork,1968
2.Highway Capacity Manual, Special Report 209, Transportation Research Board (TRB), National Research Council, Washington DC,1988
3.May A.D., Traffic Flow Fundamentals, Prentice Hall Inc., New Jersey,1990
4.Papacostas C.S., Prevedouros, Transportation Engineering and Planning, Third Edition, Prentice Hall of India, New Delhi,2002
5.Kadiyali, L.R, Traffic Engineering and Transport Planning, Khanna Publishers, Delhi,2006.

CIV 5206	PAVEMENT EVALUATION & MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Identify and select suitable design strategies for a given pavement.

CO: Determine the pavement condition using functional and structural methods.

CO3: Decide the type and timing of maintenance required for given pavement.

CO4: Evaluate and estimate the life cycle cost of pavements.

UNIT I: PAVEMENT SURFACE CONDITION & ITS EVALUATION

Various Aspects of Surface and their Importance; Causes, Factors Affecting, Deterioration and Measures to Reduce: i) Pavement Slipperiness ii) Unevenness iii) Ruts, Pot holes, and Cracks; Methods of Measurement of Skid Resistance, Unevenness, Ruts and Cracks. Pavement Surface Condition Evaluation by Physical Measurements, by Riding Comfort and Other Methods; their Applications.

UNIT II: PAVEMENT STRUCTURE & ITS EVALUATION

Factors affecting Structural Condition of Flexible and Rigid Pavements; Effects of Subgrade Soil, Moisture, Pavement Layers, Temperature, Environment and Traffic on Structural Stability, Pavement Deterioration; Evaluation by Non-Destructive Tests such as FWD, Benkelman Beam Rebound Deflection, Plate Load Test, Wave Propogation and other methods of Load Tests; Evaluation by Destructive Test Methods, and Specimen Testing

UNIT III: PAVEMENT OVERLAYS & DESIGN: PAVEMENT OVERLAYS

Design of Flexible Overlay over Flexible Pavement by Benkelman Beam Deflection and other Methods, Flexible Overlays and Rigid Overlays over Rigid Pavements, Use of Geosynthetics in Pavement Overlays.

UNIT IV: PAVEMENT MANAGEMENT SYSTEM

Historical background – general nature and applicability of systems methodology – Concepts of pavement management systems basic components of Pavement Management System – planning pavement investments.

UNIT V MODELLING

Pavement performance prediction concepts, modeling techniques, structural conditional deterioration models, mechanistic & empirical models, functional condition deterioration models, unevenness deterioration models and other models, ranking and optimization methodologies.

REFERENCES :

1. Yoder E.J. and Witezak, Principles of Pavement Design, II Ed., John Wiley and Sons, 1975.
2. Woods, K.B., Highway Engineering Hand Book, McGraw Hill Book Co.
3. David Croney, The Design and Performance of Road Pavements, HMSO Publications, 2008.
4. Haas and Hudson, Pavement Management System, McGraw Hill Book Co., New York, 1982.
5. Per Ullidtz, Pavement Analysis, Elsevier, Amsterdam,1998.
6. HRB/TRB/IRC/International Conference on Structural Design of Asphalt Pavements, 1988.
7. SHAHIN, M Y, Pavement management for airport, roads and parking lots, Chapman and hall 2005.
8. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, 2003.

CIV5207	TRANSPORTATION ECONOMICS	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Understand the planning of transit system and network.

CO2: Apply various methods to perform survey for planning of transit system.

CO3: Design the transit network by considering all important parameters.

CO4: Analyze the capacity of transit system and level of service.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H							M
CO2	L					L				L	H	M
CO3			H		M						M	
CO4											M	

UNIT I ECONOMIC EVALUATION

Need for Economic Evaluation of Urban Transport Projects – Principles of EconomicAnalysis – Methods of Economic Evaluation –Cost-benefit ratio, first year rate of return,net present value,internal rate of return methods;Indirect cost and benefits of transport projects – Case Studies

UNIT II ROAD USER COSTS

Components of vehicle operating cot – Factors affecting vehicle operating cost – Value of Travel Time Saving, Accident Cost, Sensitivity Analysis – Case Studies

UNIT III TRANSPORT ECONOMICS

Transport and Economics – Movement, Transportation and Location – The demand for Transport – The supply of transport – Direct cost of transport, External cost of transport – Subsidy in Transport

UNIT IV TRANSPORT PRICING

Transportation costs –supply snf demand- Elasticity of demand– Economics of traffic congestion- Pricing Policy – Congestion Pricing – Public and Private Transport Pricing

UNIT V FINANCING TRANSPORT SYSTEM

Characteristics of Transportation Infrastructure – Trends in Transportation Infrastructure – Investment Needs, Options and Budgetary Support in Transport Sector – Existing Financing Practices – Build, Operate and Transfer (BOT) – Principles and BOT variants - Costing Transport – Cost Recovery, Pricing – Alternative Financial Resources – Special Purpose Vehicles

REFERENCES:

1. Robert F Baker, (eds), Hand Book of Highway Engineering, Van Nostrand Reinhold Company, New York, 1975
2. Kadiyali L.E; Traffic Engineering and Transport Planning, Khanna Publishers, 1999
3. Khanna S.K., Justo, C.E.G; Highway Engineering, New Chand and Bros, Roorkee, 1998
4. Hanspeter George; Cost Benefit Analysis and Public Investment in Transport – A Survey Butterworths, London, 1973
5. The Institution of Engineers India (1997), Proceedings of the National Seminar on Infrastructure Development – Strategies for Transportation Sector, New Delhi.

CIV 5282	TRAFFIC ENGINEERING LABORATORY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Students can understand the fundamental knowledge and theories of uninterruptible traffic flow.

CO2 : The course will provide students with hands-on experience in various traffic studies and traffic data analysis.

CO2: Microscopic and macroscopic traffic parameters, traffic flow models, traffic capacity and level of service model analysis.

CO4: Various experiments for the need of development of existing traffic scenarios.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

LIST OF EXERCISES

Conduct of the following surveys related to Transport Development, Analysis, Inferences and Proposals.

Traffic Surveys: Volume count, Speed study, Parking study, Intersection turning movements, Speed and delay study moving observer survey, Traffic noise measurement, Vehicle emission testing, Road lighting, User perception surveys, Road side and house hold interviews.

SYLLABUS - ELECTIVES

CIV 5251	INTELLIGENT TRANSPORT SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Differentiate different ITS user services.

CO2: Select appropriate ITS technology depending upon site specific conditions.

CO3: Design and implement ITS components.

CO4: Understand ITS architecture and standards.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

UNIT I MANAGEMENT INFORMATION SYSTEMS

Characteristics of Information, Constituents of Computer Based Information Systems, Element and functions of Management Information Systems in Urban Transportation Sectors – Development of Database and Management Information System – Concept of Database – Development of Transportation Database

UNIT II TRANSPORTATION MANAGEMENT

Objective of Transportation Management – Core functions of Transport Management – Traffic Signal System – Freeway Management Systems (FMS) Information Technologies – Information Systems Concept – Overview of the System Development Cycle – Traditional System Development Life Cycle Methodology – Decision Support System (DSS) in Urban Transport Development

UNIT III INTELLIENT TRANSPORT TECHNOLOGIES

Wireless Communication – Computational Technologies – Floating Car Data / Floating Cellular Data – Sensing Technologies – Inductive Loop Detection – Video Vehicle Detection – Advanced Traffic Sensors and Surveillance Systems – Dynamic Message Sign (DMS) Positioning Systems – Maps – Maps Matching – Path Finding and Route Guidance, Information Dissemination and Display Technologies

UNIT IV INTELLIGENT TRANSPORT APPLICATION

Technologies for delivering Pre-Trip and En-route Traveler Information – Electronic Payment Technologies – Electronic Toll Collection – Emergency Vehicle Notification Systems – Fleet Operation and Management – Cordon Zones with Congestion Pricing, Automatic Road Enforcement

UNIT V INTELLIGENT TRAFFIC MANAGEMENT

Intelligent Speed Adaptation – Telematics – Traffic Estimation and Prediction Systems, Multimodal Travel Management and Traveler Information – SCATS Traffic Signal Systems, the Challenge of ITS and ORM versus traditional Transportation Improvements, Technical Function in Integrating ITS and Transport Planning

REFERENCES:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill, 1992
3. E.Turban, Decision Support and Export Systems Management Support Systems, Maxwell Macmillan, 1998
4. Sitausu S.Mittra, Decision Support Systems – Tools and Techniques, John Wiley, New York, 1986
5. Cycle W.Halsapple and Andrew B.Winston, Decision Support Systems – Theory and Application', Springer Verlog, New York, 1987

CIV 5252	PAVEMENT MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Analyze the stresses and strains in a flexible pavement using multi-layered elastic theory.

CO2 : Analyze stresses and strains in a rigid pavement using Westergaard's theory.

CO3: Design a flexible pavement using IRC, Asphalt Institute, and AASHTO methods.

CO4: Design a rigid pavement using IRC, and AASHTO methods.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

UNIT I PAVEMENT MANAGEMENT PROCESS

Historical background – general nature and applicability of systems methodology – basic components of Pavement Management System – planning pavement investments.

UNIT II EVALUATION AND PERFORMANCE

General concepts – economic and functional evaluation – evaluation of pavement performance – evaluation of structural capacity – pavement distresses – condition surveys – safety evaluation

UNIT III DESIGN STRATEGIES

Framework for pavement design – design objectives and constraints – basic structural response models – characterization of physical design inputs – generating

alternative pavement design – economic evaluation of alternative design – analysis of alternative design strategies – selection of optimal design strategy.

UNIT IV PERFORMANCE PREDICTION MODELS

Techniques for developing prediction models – AASHO, CRRI and HDM models – computer applications.

UNIT V REHABILITATION

Repair of pavement defects – maintenance of flexible and rigid pavements – bituminous and cement concrete overlays – system analysis

REFERENCES:

1. Ralph Haas, W.Ronald Hudson and John Zaniewski, Modern Pavement Management, Kreigar Publishing Company, New York, 1994
2. M.Y.Stalin, Chapman and Hall Pavement Management for Airports, Roads and Parking Lots , New York, 1992.
3. Michael Sargious, Pavements and surfacings for Highways and Airports, Applied Science Publishers Limited, London, 1975

CIV 5253	SUSTAINABLE URBAN AND TRANSPORT DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Helps in understanding the basic concept of Sustainable Urban and Transport Development.

CO2: Students are able to understand the urban planning and environment

CO3: Helps in understanding the basic concept of Transport Development and its influence on region, city and built environment.

CO4: Students are able to understand the various methods and tools for sustainable appraisal, sustainable transportation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

UNIT I SUSTAINABLE URBAN AND TRANSPORT PRINCIPLES

Urban Environmental Sustainability, Urban Development, Urban Sustainable Development, Methods and Tools for Sustainable Appraisal, Sustainable Transportation – Principles, indicators and its implications

UNIT II URBAN PLANNING AND ENVIRONMENT

Environment and Resources, Sustainability Assessment, Future Scenarios, Shape of Urban Region, Managing the change, Integrated Planning, Sustainable Development

UNIT III URBAN REGION AND ENVIRONMENT

City Centre, Development Areas, Inner City Areas, Suburban Areas, Periurban and Country side, Economy and Society

UNIT IV THE URBAN BUILT-IN ENVIRONMENT

Urban Form, Land Use, Compact Development, Transport Integrated Urban Planning, Housing, and Household, Services and Industry, Guidelines for Environmentally sound Transportation

UNIT V TRAVEL AND TRANSPORT

Transport and Environment – Equity Principle, Accessibility, Mobility – Roads, Traffic, Public Transport, Business and Goods Traffic, Air Quality, Energy-supply and Demand, Climate Change, Public and Private Partnership, Financing and Pricing – Economic Benefits of Sustainable Transportation

REFERENCES:

1. Joe Ravetz, City Region 2020 – Integrated Planning for a Sustainable Environment, 2000
2. George Godwin; Traffic, Transportation and Urban Planning; Pitmen Press, Great Britain , 1981
3. Sustainable Transportation and TDM – Planning the balances, Economic, Social and Ecological objectives; Victoria Transport Policy Institute, 2007
4. UNCHS, Habitat, Cities in a Globalizing world, Global report on Human Settlement, 2001.

CIV 5254	ENVIRONMENTAL LAWS AND IMPACT ASSESSMENT OF TRANSPORTATION PROJECT	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Describe the need for studying the effects of transportation systems on the environment.

CO2 : Estimate air pollution and noise pollution caused by a transportation system.

CO3: Describe the EIA study and its process.

CO4: Perform measures to mitigate air pollution and noise pollution caused by a transportation system.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

UNIT I ENVIRONMENTAL MAINTENANCE AND LEGAL SYSTEMS

Laws concerned with protection of the environment such as Environmental Protection Act, Air and Noise Pollution Act, Motor Vehicle Act, Town and Country Planning Act, Development Control Regulation, Coastal Regulation Zone

UNIT II ENVIRONMENTAL STANDARDS IN URBAN AREAS AND EIA

Importance of EIA, Environmental Appraisal, EIA Statement, Vehicle and Traffic Noise, Ambient Noise Level, Heath Effects, Vibration – Damage to building, Exhaust Emission – Pollutant, Health effects, Air Pollution, Urban Ambient Air Quality Standards, Effects on Human being, Vegetation and Animals.

UNIT III MEASUREMENT AND POLLUTION PREDICTION

Measurement of Air and Noise Pollution, Land Acquisition, Rehabilitation, Collection, Compilation and Presentation of Pollution and Impact Data, Measuring Impact before construction, at the time of construction and after construction, Prediction, Modeling and Validation.

UNIT IV MITIGATIVE MEASURES AND POLICIES

Mitigative Measures for Air and Noise Pollution Policies and Strategies, Involvement of Stakeholders, Public Participation, Institutional Arrangements

UNIT V ENVIRONMENTAL QUALITY AND MANAGEMENT

Impact of Traffic on Environment – Network Pattern, Urban Growth Indicators of Environmental Quality, Energy use, Fuel Economy in Transportation, Energy Efficiency strategies.

REFERENCES:

Larry W Canter, Environmental Impact Assessment, McGraw Hill Publishers, 1996.

1. Rao V.Kolluru; Environmental Strategies Handbook, McGraw Hill Publishers, 1994.
2. David Banister; Transport Policy and Environment E&FN Spain, 1999
3. World Bank; the Impact of Environmental Assessment – A Review of World Bank Experience, Washington, 1997.
4. World Bank; Road and the Environment, Washington, 1997.

CIV 5255	HIGHWAY SAFETY AND SAFETY AUDIT	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Analyze the effect of driver characteristics, roadway characteristics, climatic factors on highway safety.

CO2 : Students can understand the various safety measures.

CO3: Plan and design a road safety improvement program.

CO4: Analyze accident data and suggest safety measures and Conduct road safety audit.

UNIT I DESCRIPTION OF PROBLEMS

Causes of accidents – Human factors – Vehicles – Road and its condition – Environmental Studies

UNIT II ACCIDENT ANALYSIS TECHNIQUES

Collision Diagram – Preparation, Spatial Analysis of Accidents – Methods and GIS in Accident Analysis - Black Spot, Black Route and Area Identification

UNIT III BEFORE AND AFTER STUDIES

Accident Prediction Models – Development – Empirical Bayees Approach – Before and After Evaluation – Case Studies

UNIT IV SAFETY AUDIT

Need for Safety Audit – Concept and Elements of Safety Audit – Safety Audit for existing roads – Legal requirements – Provisions of Motor Vehicle Act and role of NGO's in prevention of accidents.

UNIT V ACCIDENT STUDIES AND INVESTIGATION

Accident data – Identification of Accident Prone Location – Prioritisation – Investigation – Problems and Remedies

REFERENCES:

1. Khanna S.K. and Justo C.E.G, Highway Engineering, Nem Chand and Brothers, Roorkee, 2001
2. Robert F. Baker, Hand Book of Highway Engineering, Van Nonstrant Keinhold Company, New York, 1975
3. Ministry of Surface Transport, Accident Investigation and Prevention Manual for Highway Engineers in India, Government of India, 2001
4. Robert F.Baker, The Highway Risk Problem – Policy Issues in Highway Safety, John Wiley and Sons.

CIV 5256	REMOTE SENSING AND GIS IN TRANSPORT DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1: Develop GIS-T Data Models and Represent Transportation Data in GIS Environment.

CO2: Analyse Transport Networks.

CO3: Analyse and model spatial and transportation facilities in GIS and Integrate ITS with GIS.

CO4: Map transportation related environmental pollutants, accidents in GIS platform.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					L		M
CO2					H	L					M	L
CO3	L		M								H	
CO4			H								M	

UNIT I INTRODUCTION TO REMOTE SENSING

Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body – Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Electromagnetic Radiation – EMR Spectrum

UNIT II INTRODUCTION TO GIS

Basic Concept and Components – Hardware, Software – Data Spatial and non-spatial – Geo-referencing – Map Projection – Types of Projection – Simple Analysis – Data retrieval and querying

UNIT III DATA STRUCTURES AND ANALYSIS

Database – Raster and Vector data structures – Data storage – Run length, Chain and Block coding – Vector data storage – Topology – GIS Modelling - Raster and Vector data analysis – Buffering and overlaying techniques – Network Analysis – Spatial Analysis

UNIT IV BASIC APPLICATIONS IN TRANSPORTATION

Highway and Railway Alignment, location of transport terminals and roadside facilities, bus stops – Route optimization – Bus route rationalization – Accident analysis – Applications of Aerial Photography and Satellite Imageries

UNIT V ADVANCED APPLICATIONS

GIS as an integration technology – Integration of GIS,GPS and Remote Sensing Techniques – Advanced Traveler Information System (ATIS) – Automatic Vehicle Location SysteM

REFERENCES:

1. Anji Reddy, Remote Sensing and Image Interpretation, John Wiley and Sons Inc. New York, 1987.
2. M.G.Srinivas, Remote Sensing Applications, Narosa Publishing House, 2001.
3. Burrough P.A, Principles of GIS for Land Resources Assessment, Oxford Publication, 1994.
4. Jeffrey Star and John Ester, Geographical Information System – An Introduction, Prentice Hall Inc., Englewood Cliffe, 1990.
5. Marble, D.F, Calkins, H.W and Penquest, Basic Readings in GIS, Speed System Ltd., New York, 1984.

CIV 5257	RAIL TRANSPORTATION SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Understand the importance of railway infrastructure planning and design

CO2 : Identify the factors governing design of railway infrastructures

CO3: Apply track design principles, components and design criteria

CO4: Execute the minor and major projects related to railway infrastructure.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H		H					L		L
CO2					M	L					L	M
CO3	M		M								M	
CO4			M								H	

UNIT I INTRODUCTION

Railway Industry – Privatization – Financing – Competition with Road Transport.

UNIT II DEPENDABILITY ASPECTS

Regularity, Reliability, Punctuality and Safety – Modern tools to improve dependability – Time Table – Development – Scheduling – Restoring.

UNIT III MANAGEMENT OF RAILWAY OPER

Demand based Railway Planning – Freight and Passenger Train Services – Asset Maintenance and Management

UNIT IV URBAN RAIL TRANSIT PLANNING

Urban Rail Transit Planning – MRTS – LRTS, Metro Rail – Monorail – Network Design, Capacity and Traffic Forecasting - Case Studies

UNIT V RAILWAY INFRASTRUCTURE

Modern Transit Facilities - Railway Track – Transfer Station – Structures –

Bridges – Tunnels – Planning and Design aspects

REFERENCES:

1. Brain Richards, Transport in Cities
2. Roberty Cervero, The Transit Metropolis, Island Press, 1998
3. Vukan R.Vuchie, Urban Transit: Operations, Planning and Economics, John Wiley and Sons Inc., 2005
4. Vukan R.Vuchie, Urban Transit Systems and Technology, John Wiley and Sons, 2007.

CIV 5258	AIRPORT PLANNING, SCHEDULING AND CONTROL	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Analyze the effects of atmospheric variables on aircraft performance.

CO2 : Design the geometrics of the airport infrastructure.

CO3: Prepare structural designs of runway, taxiway, and apron-gate area.

CO4: Prepare a plan of the airport terminal area.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			L		H					M		H
CO2	L				M	M					L	M
CO3			M								H	
CO4			H								L	

UNIT I AIRPORT PLANNING

Airport – Accessibility – Transport Connections – Road and Rail, Expansion – Feasibility Studies – Environmental and Social Issues – Forecasting Future Traffic – Airfield Capacity and Delay - Aircraft characteristics – Airport Site Selection

UNIT II AIRPORT COMPONENTS

Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hanger, Passenger Terminals

UNIT III AIR ROUTE PLANNING AND EVALUATION

Demand driven dispatch – Airline Fleet Planning Models – Network Revenue Management – Airport Performance, Slot Issues, Hub Operation, Demand Management, Multi-airport Systems

UNIT IV PASSENGER CHOICE, SCHEDULING AND FLEET ASSIGNMENT

Load Factor Analysis, Airline Schedule Development, Introduction to PODS Passenger Choice Models, Decision Window Model, Fleet Assignment

UNIT V AIRLINE ECONOMICS

Pricing – Privitization and Deregulation, Willingness to pay and Competitive Revenue Management

REFERENCES:

1. Robert Honjeff and Francis X.Mckelvey, Planning and Design of Airports, McGraw Hill, New York, 1996
2. Richard De Neufille and Amedeo Odoni, Airport Systems Planning and Design, McGraw Hill, New York, 2003
3. Airport Planning and Systems – http://airportssystems.com/Course/index-html
4. S.K.Khanna and M.G.Arora, Airport Planning and Design, Nem Chand and Bros, 1999.

CIV 5259	WATERWAYS TRANSPORTATION SYSTEM, PLANNING AND DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Plan and design harbour facilities

CO2 : Estimate Traffic demand for harbour planning

CO3: Understand repair facilities, port facilities and cargo handling facilities required.

CO4: Understand navigational aids and inland navigation for safe operations.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			L		H					L		H
CO2					M	L						M
CO3	L		H								M	
CO4			M								M	

UNIT I INTRODUCTION

Fresh Water and Salt Water Navigation – Ocean, Currents and Tide – Canals and Waterways – Ports – Types of Ships

UNIT II LOGISTICS AND MULTIMODAL TRANSPORT

Containers – Distribution and Collection by Road and Rail – Vehicles and Equipment used – Trade Routes

UNIT III PORT AND TERMINAL MANAGEMENT

Role of ports in trade and transport – Port facility for handling liner, dry bulk and liquid trade – Basics of Port Business – Customs – Immigration, Por Health – Marine Safety - Pricing

UNIT IV PORT PLANNING

Traffic Forecast, Demand, Users, Capacity – Berth occupancy – Service time – Waiting time – Principles of Planning Port Layout – Handling

characteristics – Voyage Estimating

UNIT V INLAND WATER AND OTHER MODES OFTRANSPORT

Inland Water Transport – Planning, limitations and advantages – Case Studies –Pipelines – Ropeways – Beltways – other means of transport – Characteristics and Applications.

REFERENCES:

1. Leslie A.Bryan, "Principles of Water Transportation", University of Chicago Press
2. Paul H.Wright, J.Ashford Norman, "Transportation Engineering, Planning and Design", John Wiley and Sons Inc., 1997
3. "Shipping and Inland Water Transport for Eleventh Five Year Plan" – Report by Planning Commission, Prentice Hall Inc., Englewood Cliffe, 1990.
4. Marble, D.F, Calkins, H.W and Penquest, Basic Readings in GIS, Speed System Ltd., New York, 1984.

CIV 5260	URBAN TRANSPORTATION INFRASTRUCTURE, PLANNING AND DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Identify urban transportation problems.

CO2 : Estimate urban travel demand.

CO3: Plan urban transport networks.

CO4: Prepare urban transportation plans.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			L		L					L		L
CO2					H	L					L	H
CO3	M		H								H	
CO4			M								H	

UNIT I PRINCIPLES OF INTERSECTION DESIGN

Basic consideration– simplicity – uniformity – Maneouvre Elements – Separation of conflict points – Design Elements – Design Speed – Intersection Curves – Super elevation for curves at Intersection – Intersection Sight Distance

UNIT II DESIGN OF AT-GRADE INTERSECTIONS

Capacity and LOS, Design of Rotary and Signalised Intersections, Vehicle Actuated Signals, Signal Co-ordination, Area Traffic Control System (ATCS), Pedestrian Planning at Grade Intersections

UNIT III DESIGN OF GRADE SEPARATED INTERSECTIONS

Design of Grade Separators – Principles , Design Criteria – Layout Design, GAD Preparation – Pedestrian Foot Over-bridge and Subway Design – Pedestrian Planning for Grade Separated Intersections

UNIT IV PARKING FACILITIES

Parking – Demand – Characteristics – Space Inventory – Accumulation – Duration – Turn over – Index – Design of Multi Storeyed and Surface Parking facility

UNIT V DESIGN OF TERMINAL FACILITIES

Bus Terminus – Design Principles – Design Elements – Design and Case Studies of Inter Modal Transfer Facilities – Design – Case Studies of Bus and Rail Terminals

REFERENCES:

1. Robert F Baker, (Eds) Hand Book of Highway Engineering, Van Nostrand Reinhold Company, New York, 1975
2. New Jersy, Transportation and Traffic Engineering Hand Book, Institute of Transportation Engineers, Prentice Hall, INC, 1982
3. Kanna, S.K. and Justo, C.E.G. Highway Engineering, Nemchand and Brothers, Roorkee, 1998

CIV5261	ADVANCED SYSTEM DYNAMIC MODELLING IN TRANSPORTATION	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course, students would be able to

CO1 : Understand different optimisation techniques and simulation tools

CO2 : Solve linear, no-linear and dynamic programming problems

CO3: Find feasible solution to transportation problems

CO4: Develop queuing models for traffic flows

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		H					M		H
CO2					M	L					M	L
CO3	M		L								L	
CO4			M								L	

UNIT I COMPLEXITY AND SYSTEMS THINKING

Change – Complexity and Interdependency – Systems thinking – Floundering – Level of abstractions – Tools and Transitions in Systems Thinking – Synthesis and Organisational Learning

UNIT II ADVANCED MODELING EFFORTS

Steady State Modeling – Discrete vs. Continuous – Generic infrastructures – Subsystems – Sensitivity parametering - Case Studies

UNIT III ADVANCED SIMULATING TECHNIQUES

Graphical Bulletin function – Conveyor flows – Converter – Flow substitutes – Connector – Normalising Inputs – Generic flow activities – Case Studies

UNIT IV MODELING PROCESS

System Dynamics Modeling challenges – Steps in Modeling Process – Guidelines – Model Boundary – Modeling soft variables – Quantification vs. Measurement.

UNIT V SOPHISTICATED DYNAMICS MODELING

Need – Isolation Process – Demand Expansions – Cycle functions – Sensitivity Analysis – Alternative view of Dynamic Modeling

REFERENCES:

1. Pratab Mohapatra K.J. et al., Introduction to System Dynamics Modeling, University Press, Hyderabad, 1994

2.Thirumurthy A.M., Environmental Facilities and Urban Development in India – A System Dynamics Model for Developing Countries, Academic Foundations, India, 1992

3.Umadevi, G, Land Use Transport Interaction Modeling – A Systems Approach, Ph.D thesis, Division of Transportation Engineering, College of Engineering, Guindy, Anna University, Chennai, 2001

4.Technical Manual on An Introduction to Systems Thinking – STELLA Research Software, High Performance Systems Inc., Hannover, 1996

5.Advanced Manual on An Introduction to Systems Thinking – STELLAII Research Software, High Performance Systems Inc., Hannover, 2002