DEPARTMENT OF CIVIL ENGINEERING

COURSE STRUCTURE

(1ST – 4TH SEMESTER)

FOR

M. TECH PROGRAMME

SPECIALISATION

IN

TRANSPORTATION ENGINEERING

(EFFECTIVE FROM July 2019)

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY

(FORMLY, UNIVERSITY COLLEGE OF ENGINEERING)

BURLA – 768 018, SAMBALPUR, ODISHA

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 engineers and reasearchers, truly world class leaders and unleash technical 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 etics in its products by inculcating depth and intensity in its education standards and need based research through

- 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 involvement of all faculty members.
- Facilitating technology transfer, innovation and economic development to flow as natural results of research wherever appropriate.
- Expanding curricula to cater broader perspectives.
- Creation of service opportunities for upliftment of the society at large.

POs

- An ability to independently carry out research /investigation and development work to solve practical problems
- An ability to write and present a substantial technical report/document
- Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
- Ability to apply knowledge of mathematics, science and engineering to solve complex problems in civil engineering
- Ability to identify, formulate, and solve complex civil engineering problems using first principle

of mathematics, basic science & engineering

- Ability to design and conduct complex civil engineering experiments as well as to analyze and interpret the experimental data

PEOs:

- To lead a successful career in industries, pursue higher studies and entrepreneurial endeavors.
- To offer techno-commercially feasible and socially acceptable solutions to real life engineering problems.
- To demonstrate effective communication skill, professional attitude and a desire to learn.

PSOs:

- Plan, analyze, design, prepare and execute all kinds of Water Resources Engineering projects.
- Apply latest construction techniques for successful completion of time bound Water Resources Engineering projects with optimized cost.

Course Structure for PG Programmes (TRANSPORTATION ENGINEERING/CE) to be introduced from July 2019

Semester I

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Core-1	MCETE101	Traffic Engineering and Management	3	0	0	3
2	Core-2	MCETE102	Pavement material characterization	3	0	0	3
3	PE-1		Programme Elective 1	3	0	0	3
4	PE-2		Programme Elective 2	3	0	0	3
5	Common		Research Methodology & IPR	2	0	0	3
6	Lab-1	MCETE103	Traffic engineering lab	0	0	3	2
7	Lab-2	MCETE104	Highway materials lab	0	0	3	2
8	Audit -1						
Total Credits							19

Semester II

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Core-3	MCETE201	Traffic Analysis	3	0	0	3
2	Core-4	MCETE202	Pavement Analysis and design	3	0	0	3
3	PE-3		Programme Elective 3	3	0	0	3
4	PE-4		Programme Elective 4	3	0	0	3
5	Common		Mini project	0	0	4	2
6	Lab-3	MCETE203	Pavement Design	0	0	3	2
7	Lab-4	MCETE204	Traffic modelling	0	0	3	2
8	Audit -2						
Total Credits							18

Semester III

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	PE-5		Programme Elective 5	3	0	0	3
2	OE-1		Open Elective 1	3	0	0	3
3	Minor Project		Dissertation (Phase-I)	0	0	20	10
Total Credits							16

Semester IV

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Major Project		Dissertation (Phase-II)	0	0	32	16
Total Credits							16

GRAND TOTAL CREDITS: 19+18+16+16= 69

Sl. No.	Course Code	Programme Elective 1
1	MTEPE101	Transportation infrastructure design
2	MTEPE102	Project Management
3	MTEPE103	Traffic Flow Modelling
4	MTEPE104	Computational and statistical methods in transportation engineering
Sl No.		**Programme Elective 2**
1	MTEPE105	Urban Transportation Planning
2	MTEPE106	Highway project formulation and economics
3	MTEPE107	Traffic management and design
4	MTEPE108	Intelligent transportation systems
Sl No.		**Programme Elective 3**
1	MTEPE201	Highway construction practise
2	MTEPE202	Remote sensing and GIS application in transportation engineering
3	MTEPE203	Public transport
4	MTEPE204	Transportation System Management
Sl No.		**Programme Elective 4**
1	MTEPE205	Planning and Design of Airports
2	MTEPE206	Modelling of pavement materials
3	MTEPE207	Analysis of transportation systems
4	MTEPE208	Low volume roads
Sl No.		**Programme Elective 5**
1	MTEPE301	Land use transportation modelling
2	MTEPE302	Pavement construction maintenance and management
3	MTEPE303	Environmental Impact Assessment
4	MTEPE304	Behavorial travel modelling
Sl No.		**Open Elective 1**
1	MTEOE301	Optimization Techniques
2	MTEOE302	Computational and statistical methods
3	MTEOE303	Applications of GIS

Audit course 1 & 2

Sl.No.	Course Code	Subject Name
1.	BCAC1001	English for Research Paper Writing
2.	BCAC1002	Disaster Management
3.	BCAC1003	Sanskrit for Technical Knowledge
4.	BCAC1004	Value Education
5.	BCAC2001	Constitution of India
6.	BCAC2002	Pedagogy Studies
7.	BCAC2003	Stress Management by Yoga
8.	BCAC2004	Personality Development through Life Enlightenment Skills.

PROGRAMME ELECTIVE – I

TRANSPORTATION INFRASTRUCTURE DESIGN

Module I

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

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

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

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.

Module V

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.

Note: Use of highway geometric design software for design of intersections, alignment.

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. Relevant IRC Codes / Specifications.

Course outcomes:

1. Use geometric elements of Cross Section of various types of roads.
2. Design geometric elements of Horizontal Alignment of Roads
3. Construct geometric elements of Vertical Alignment of Roads.
4. Evaluate various devices for traffic management.
5. Express Pedestrian facilities.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**	**1**			**2**	
CO 2			**2**			
CO 3	**3**				**2**	
CO 4		**2**				**3**
CO 5				**1**		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	0	0	1	1

PROJECT MANAGEMENT

Module-I

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

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

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

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.

Module-V

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:

1. Review project estimation process
2. Use project scheduling and planning tools
3. Analyze pre and post project processes.
4. Apply project planning process using computer application.
5. Evaluate the theoretical concept in project scheduling using computer application

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1		**2**		**3**	**2**	
CO 2		**3**		**1**	**2**	
CO 3		**1**	**1**	**3**	**3**	
CO 4			**1**	**1**	**2**	
CO 5			**3**		**1**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	0	1	1	2	2	0

TRAFFIC FLOW MODELLING

Module-I

Traffic Stream Characteristics: Types of Facilities, Traffic Stream Parameters, Volume and Rate of Flow , Speed and Travel Time, Density and Occupancy, Spacing and Headway, Microscopic Parameters, Representation of Cross-Sectional Data, Relationships among Flow Rate , Speed, and Density.

Module-II

Time Space Diagram: Trajectories of a single vehicle, Trajectories of a single vehicle, Application of distance–time diagram, Cumulative Plots. Traffic Flow Theory: Stationary traffic, time independent models, The Conservation Law, Dynamic macroscopic models, Dynamic microscopic model.

Module-III

Two interacting traffic streams, Saturation and under saturation, timing plan for variable and deterministic traffic, actuated control

Module-IV

Weaving, Merging, and Diverging Movements on Freeways and Multilane Highways,

Module-V

Three Detector Problem, Signing and Marking for Freewaysand Rural Highways, classification of road marking.

Text book:

1. Traffic Flow Theory: A Monograph, TRB Special Report
2. Fundamentals of Transportation Engineering – C. S. Papacostas, Prentice Hall India Publication

Reference books:

1. Principles of Highway Engineering and Traffic Analysis - F.L.Mannering & W.P.Kilareski, John Wiley Publishers.
2. Traffic Flow Fundamentals – A.D.May, Prentice Hall India Publication
3. Fundamentals of Traffic Engineering – McShane & Rogers, 1977.

Course outcomes:

1. Review traffic stream characteristics
2. Apply traffic flow theory in different scenario
3. Use traffic stream interaction.
4. Design different traffic safety facility
5. Evaluate different traffic problems, signs, markings

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**	**3**	**2**			
CO 2	**1**	**1**	**3**	**3**	**2**	
CO 3	**3**	**3**	**3**	**2**	**3**	
CO 4				**1**	**3**	
CO 5		**2**				**3**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	2	2	1	2	1

PROGRAMME ELECTIVE – II

URBAN TRANSPORTATION PLANNING

Module - I

Urban Transportation Planning Process: Transport Planning Morphology, Traditional Four-Step Travel Demand Forecasting, Need for Travel Demand Forecasting

Module - II

Urban Travel and Transportation Systems Characteristics, Considerations in Trip Generation, Trip Classification, Factors Affecting Trip Generations, Multiple Regression Analysis, Trip Generation Model Application

Module - III

Travel Demands Forecasting- trip generation, Modeling of Trip Generation: Cross Classification, Trip Generation Model Calibration, Stability of Trip Generation Model

Module - IV

Trip distribution - Considerations in Trip Distribution, Factors affecting trip distribution, Methods & Calibration

Module - V

Modal split and trip assignment, Transport Behavior of Individuals and House holds, Land use/ Transportation systems, Introduction to Urban Freight Transportation and Urban Mass Transportation Systems.

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

Course outcomes:

1. Identify urban transportation problems.
2. Use factors influencing urban travel demand
3. Estimate urban travel demand
4. Compute trip interchange
5. Evaluate modal share and flow on transportation link

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**3**			**3**		**3**
CO 2		**2**		**1**		
CO 3	**3**	**3**	**1**	**1**	**3**	**3**
CO 4			**3**	**2**		**3**
CO 5			**2**		**2**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	1	1	1	2

HIGHWAY PROJECT FORMULATION & ECONOMICS

Module-I

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

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

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

Project appraisal by shadow pricing with case studies; Toll system analysis, financial analysis; Budgeting. Environmental impact assessment: Basic Concepts, Objectives

Module – V

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:

1. Review the process and life cycle of a project
2. Use economic cost evaluation
3. Analyze the feasibility of highway projects.
4. Prepare project appraisal report
5. Evaluate the need for environmental impact assessment.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**					
CO 2		**2**				
CO 3	**3**					**2**
CO 4			**1**	**2**		
CO 5	**1**	**1**	**3**	**3**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	1	1	0	0

TRAFFIC MANAGEMENT AND DESIGN

Module - I

Traffic Impact: Transportation noise: standards, measurements and mitigation strategies. Parking Studies: Statistics and analysis. Fuel Consumption and vehicle operating cost. Vehicular emission and Air quality modeling, Environmental impact assessment

Module - II

Traffic safety: Accident studies, Accident data analysis, Statistical methods for data analysis, Road safety principles and practice, Identification of hazardous locations. Capacity and LOS analysis: Two Lane Highways, Urban Streets, Multilane Highways, Transit systems, Pedestrians and bicycles.

Module - III

Design of Traffic Facilities: Transit route selection and design, Pedestrians and bicycles facilities, Intersection, roundabout configuration and design, Interchange design, Freeway Operations and design.

Module - IV

Traffic Management: Traffic Management Strategies, Traffic Management Techniques, Work zone traffic management, Traffic calming, Congestion studies and Road pricing. Automated Data Collection Systems: Intrusive systems such as loop detectors, pneumatic, etc.

Module – V

Non-Intrusive systems such as video, infra-red, In-vehicle systems: GPS, Mobiles, Tracking; Positioning systems for location services, Geographical information systems Intelligent Transportation System: ITS: User services and architecture, ITS: Standards and evaluation, Public transport and bus priority, Travel time estimation methods, Artificial intelligence in advanced traffic and ITS "

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 / Specifications
7. Highway Capacity Manual -2010.

Course outcomes:

1. Review the factors affecting traffic standards.
2. Use the factors for improvement of traffic safety
3. Design traffic facilities
4. Evaluate traffic management strategies
5. Compute and implement ITS components.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**	**1**		**2**	**3**	**3**
CO 2	**3**	**1**		**1**	**1**	
CO 3	**3**	**2**	**1**	**3**	**3**	**2**
CO 4	**2**	**1**		**3**	**3**	
CO 5				**3**		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	1	0	2	2	1

INTELLIGENT TRANSPORTATION SYSTEMS

Module-I

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

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

Module-III

ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection., 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),

Module-IV

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-V

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

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:

1. Differentiate different ITS user services.
2. Review the ITS sensor technology
3. Use appropriate data collection and management techniques
4. Select appropriate ITS technology depending upon site specific conditions.
5. Design and implement ITS components.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**			**2**		
CO 2	**3**		**1**		**2**	
CO 3	**3**		**3**	**1**	**1**	**3**
CO 4	**2**	**3**	**1**			**2**
CO 5			**2**	**1**		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	1	1	1	1	1

PROGRAMME ELECTIVE – III

HIGHWAY CONSTRUCTION PRACTICE

Module-I

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

Module-II

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

Module-III

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

Concrete road construction: Test on Concrete mixes, Construction equipments, Method of construction of joints in concrete pavements, Quality Control in Construction of Concrete pavements,

Module – V

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 / Specifications

Course outcomes:

1. Prepare quality assurance and quality control plans in an attempt to make better embankment
2. Construct pavements based on the functional and structural characteristics.
3. Review constructions of bituminous pavements.
4. Summarize constructions of concrete pavements.
5. Evaluate the maintenance and overlay construction.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1		**3**		**3**	**1**	
CO 2	**3**	**2**		**2**	**3**	
CO 3		**3**	**1**	**1**	**2**	
CO 4	**1**		**2**	**3**	**3**	
CO 5			**1**		**3**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	2	1	2	2	0

GIS APPLICATIONS IN TRANSPORTATION ENGINEERING

Module-I

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

Module-II

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

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

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.

Module - V

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:

1. Review components and geo referencing system of GIS
2. Use the data representations and standards
3. Analyze raw data and its modeling
4. Apply GIS concept in transportation system
5. Evaluate GIS to study EIA

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**1**	**2**		**1**	**1**	**2**
CO 2	**2**	**3**	**2**			
CO 3	**2**	**1**		**1**	**2**	**3**
CO 4	**1**	**1**		**3**	**3**	
CO 5	**3**	**2**	**2**	**2**	**3**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	2	1	1	2	1

PUBLIC TRANSPORTATION

Module-I

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

Module-II

Transit system operations, Para-transit systems, street transit systems, rapid transit systems, estimation of transit demand.

Module-III

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-IV

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-V

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
2. Fundamentals of Transportation Engineering - C.S.Papacostas, 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:

1. Review modes of public transportation
2. Evaluate different transit operations
3. Summarize different route development processes

4. Compute capacity of different transit systems
5. Design intermediate public transportation system

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	2	1			2
CO 2	1	2	1		1	
CO 3			3		2	3
CO 4	3	3	2	2	2	
CO 5			1	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	2	1	1	1

TRANSPORTATION SYSTEM MANAGEMENT

Module-I

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

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

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

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.

Module-V

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:

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

Course outcomes:

1. Review TSM, the need for TSM and the objectives of TSM.
2. Summarize the types of TSM strategies.
3. Use recommend methods to manage a transit system to improve its management efficiency.
4. Apply the concepts of bus route networks and issues in route evaluation.
5. Evaluate the importance of non auto modes and advanced transit technology.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**					
CO 2		**3**		**2**		
CO 3	**3**					**2**
CO 4			**2**	**1**		
CO 5	**3**	**1**	**1**	**3**	**3**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	1	1	1	1	0

PROGRAMME ELECTIVE – IV

PLANNING & DESIGN OF AIRPORTS

Module-I (10 Hours):

Classification of airports: ICAO standards. Aircraft characteristics, Planning for airport, airport components

Module-II (10 Hours):

Obstruction criteria, zoning laws, Runways Orientation and Geometric Design: Runway patterns.

Module-III (10 Hours):

Taxiways alignment geometry and turning radius exit taxiways, geometric, standards, fillets, high speed exit taxiway, apron-gate area and circulation

Module-IV (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-V (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:

1. Prepare airport plan
2. Design runway pattern and orientation
3. Use recommend methods to design taxiways
4. Review the concepts of apron planning and design
5. Evaluate airport landscaping.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**1**		**1**			
CO 2		**3**		**3**	**2**	**2**
CO 3	**3**		**2**			
CO 4			**2**	**1**		
CO 5	**1**	**2**	**1**	**3**	**2**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	1	1	1	0

MODELING OF PAVEMENT MATERIALS

Module – I

Role of constitutive modeling; Laboratory testing in relation to constitutive modeling: elastic modulus, resilient modulus, complex modulus, creep, rheological tests

Module – II

Introduction to continuum mechanics: strain tensor, stress tensor, isotropy, anisotropy, constitutive relationships

Module – III

Factors affecting material behavior: temperature, rate, time and confining pressure

Module – IV

Unbound materials: soil, aggregate; Bound materials: binding using asphalt, water, lime, polymer, flyash, cement; Constitutive models: unbound materials and bound materials

Module - V

Field performance of pavement materials: fatigue, rutting, temperature issues, moisture damage, permeability; Transfer functions to relate laboratory performance with field performance.

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:

1. Review Laboratory testing in relation to constitutive modeling.
2. Use continuum mechanics
3. Evaluate Factors affecting material behavior.
4. Distinguish bound and unbound materials
5. Analyze performance of pavement materials.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**3**			**3**		**1**
CO 2		**1**		**3**		
CO 3	**3**		**3**			
CO 4		**3**		**1**	**2**	**1**
CO 5	**2**		**3**			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	1	1	1	0	0

ANALYSIS OF TRANSPORTATION SYSTEMS

Module - I

Introduction: transportation systems, transportation innovations, social and economic impacts of transportation, Decision makers and their options, demand modelling and predictions, Modelling transportation systems

Module – II

Analysis of network flows: Shortest-Path Problems, Maximum-flow Problems, Minimum-cost network flow problems, Minimum Spanning tree problem

Module – III

Static Traffic Assignment: All-or-nothing (AON) assignment, Link cost function, Equilibrium principles: User Equilibrium (UE) and System Optimal (SO), Formulations of SO and UE, Uniqueness of UE and SO formulations, multi-mode traffic assignment, Variable Demand assignment, Stochastic Traffic Assignment, Solution of traffic assignment problems

Module – IV

Dynamic Traffic Assignment (DTA): Introduction, Point queue model, Cell Transmission Model, Whole link model, Dynamic user equilibrium (DUE), Analytical Models of DUE, Solution of DUE formulations, Simulation based DUE

Module – V

Public Transportation Systems: Transit Assignment, Transit route network planning, performance monitoring, vehicle and crew scheduling, Decision Making in Transportation Networks: Congestion pricing, network design problems, prioritizing investment Optional Topics: Integrated land-use and transport modelling, Activity based travel demand modelling, Entropy in the analysis of utility maximizing systems, Entropy maximization and gravity models

Text book:

1. Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India
2. Metropolitan Transportation Planning, John W Dickey, Tata McGraw Hill

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:

1. Analyze the future forecast using models.
2. Review the land use and transportation interaction.
3. Evaluate and analyze of traffic assignment.
4. Compute dynamic traffic assignment problems.
5. Design a public transportation system

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**3**	**1**		**2**	**1**	**1**
CO 2	**3**		**1**			
CO 3		**2**		**3**	**2**	**3**
CO 4	**1**		**1**			
CO 5				**2**		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	0	1	1	1

LOW VOLUME ROADS

Module I

Planning of Low volume roads: Introduction to planning of low volume roads, concepts of network planning, selection of roadway alignment, factors affecting route selection, engineering surveys for new road location.

Module II

Geometric design parameters: basic principles of geometric design, design of horizontal alignment, curves, super elevation, design of vertical alignment, summit curve, and valley curve standard of design of low volume road.

Module III

Materials: Road materials for pavement construction, soil-subgrade, road aggregate, binder, test on soil, test on aggregates and test on bitumen, bituminous mix design, marshal stability methoid for mix design.

Module IV

Design of pavement: Factors affecting pavement design function of pavement components, design of flexible pavement by IRC / AASHTO / Other procedures. Design of rigid pavement by using IRC method

Module V

Road construction: Specifications of material and construction of sub grade, subbase, base and surface layer, construction of non bituminous road, construction of bituminous roads, equipment required for construction, maintenance of low volume roads

Text Book:

1. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.

Reference Book :

- Relevant IRC Codes / Specifications
- A. Veeraragavan, S.K Khanna and C.E.G. Justo, Highway Engineering, Nem Chand & Brothers, 2014.
- Overlay design of Low volume road using light weight deflectometer by Adigopula, Vinod Kumar.

Course outcomes:

1. Review low volume road network.
2. Use knowledge about geometric design parameter for low volume roads.
3. Apply knowledge about the materials and pavement design for low volume roads

4. Evaluate the construction and specifications for low volume roads.
5. Summarize the importance of quality control in construction and maintenance of rural roads.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**1**			**2**		
CO 2	**1**		**1**		**3**	
CO 3	**2**		**1**			
CO 4		**1**		**3**	**1**	**1**
CO 5	**3**		**2**			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	0	1	1	1	0

PROGRAMME ELECTIVE – V

LAND USE TRANSPORTATION MODELLING

Module-I

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

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

General Travel Demand Models and Regional Transport Models: Aggregate, Disaggregate models ; Behavioural models; Recursive and direct demand Models; Linear, Non-Linear models;

Module-IV

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-V

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:

1. Review the relation between landuse and transportation.
2. Evaluate the fundamentals of land use theory.
3. Analyze types of travel demand models
4. Use types of intercity and intracity travel demand models
5. Assess the transportation network performance

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**			**3**		
CO 2	**1**		**1**		**1**	
CO 3	**2**		**3**	**3**	**1**	**2**
CO 4	**2**	**3**	**2**			**2**
CO 5	**3**	**1**	**1**	**2**	**3**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	1	1	2	1	1

PAVEMENT CONSTRUCTION MAINTENANCE AND MANAGEMENT

Module-I

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

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;

Module-III

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-IV

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-V

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:

1. Evaluate (functional and structural) existing pavement.
2. Distinguish Maintenance of the pavement (flexible and rigid).
3. Review pavement performance modelling.
4. Analyze construction of different layers of pavement.
5. Use bituminous construction.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**3**	**2**			**2**	
CO 2		**1**		**3**		**2**
CO 3		**3**		**3**	**2**	**2**
CO 4		**1**	**2**	**3**		
CO 5	**1**		**1**			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	1	2	1	1

ENVIRONMENTAL IMPACT ASSESSMENT

Module-I

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

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

Module-III

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

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

Module-IV

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-V

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:

1. Describe the environmental imbalances, indicators and explain the concept of EIA
2. Identify and describe elements to be affected by the proposed developments and/or likely to cause adverse impacts to the proposed project, including natural and man-made environment;
3. Compute the negative impacts and propose the provision of infrastructure or mitigation measures
4. Assess the impacts of various development on environment
5. Summarize the methodologies for carrying out environmental impact assessment

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**1**	**2**	**3**			
CO 2	**3**	**2**				
CO 3	**2**	**1**	**1**	**3**	**2**	**2**
CO 4	**2**	**2**		**2**		
CO 5	**3**			**2**		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	1	1	1	0	0

BEHAVIORAL TRAVEL MODELING

Module – I

Survey design and analysis: travel surveys and their role in transport planning, survey methods, precision and accuracy in travel surveys, sample design, sampling procedures

Module – II

Survey format, pilot surveys, survey administration, collection of stated and revealed preference data, survey data processing.

Module – III

Individual choice theory: binary choice models, multinomial and multi-dimensional choice models, issues in model specification, methods and statistics of model estimation with emphasis on maximum-likelihood estimation, aggregation and forecasting with discrete choice models

Module – IV

Validation and transferability aspects, ordered multinomial models, nested logit models, introduction to advanced concepts such as accommodating unobserved population heterogeneity in choice behavior,

Module - V

Mixed logit models, joint stated preference and revealed preference modeling, and longitudinal choice analysis; discrete choice models for integrated land use and transport modelling, review of state-of-the-art and future direction.

Course outcomes:

1. Identify the importance of urban travel demand analysis in a society
2. Design a survey process and use appropriate data analysis and model building methods in an urban travel demand study.
3. Evaluate critically the use of different discrete choice models for analyzing travel demand and assess their appropriateness, accuracy and limitations.
4. Discuss the need for behavioural modeling approach in the management of urban travel demand.
5. Formulate real world disaggregate travel demand problems in scientific terms and plan for a rational solution using discrete choice models.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**3**			**2**		
CO 2	**2**		**3**		**2**	
CO 3	**3**		**1**			
CO 4		**1**		**3**	**3**	**2**
CO 5	**1**		**1**			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	0	1	1	1	0

CORE - I

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

Module I

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

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

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.

Module IV

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 V

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:

1. Conduct traffic survey, collects data, analyse and interpret them.
2. Manage parking
3. Analyse los of an operating highway.
4. Design of signal and manage the traffic.
5. Develop short term traffic management.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**1**	**2**		**1**	**2**	**1**
CO 2	**2**	**3**	**2**			
CO 3	**3**	**3**		**2**	**1**	**2**
CO 4	**3**	**3**		**1**	**2**	
CO 5	**2**	**3**	**2**	**1**	**3**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	3	1	1	2	1

CORE - II

PAVEMENT MATERIALS AND CHARACTERIZATION

Module I

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

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

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.

Module IV

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 V

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:

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

3. Relevant IRC, IS other Codes of Practices

Course Outcomes:

1. Use Characterization of subgrade soil.
2. Evaluate Characterization of road aggregates.
3. Apply Characterization of paving grade bitumen.
4. Compare and Characterize modified bitumen and study reheological properties.
5. Compute cement used in road construction.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**2**	**2**	**3**			**1**
CO 2	**3**	**3**	**2**		**1**	
CO 3			**3**		**2**	**1**
CO 4	**2**	**2**	**3**	**1**	**1**	
CO 5	**3**	**1**	**3**		**2**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	2	2	3	0	1	0

TRAFFIC ENGINEERING LABORATORY

1. Traffic volume studies
2. Speed studies
3. O & D studies
4. Signalised and non-signalised intersection studies
5. Parking surveys
6. Design service volume and capacity studies
7. To determine the macroscopic variable data using the moving observer method
8. To carry out parking study on a chosen area and to find out the parking statistics by license plate method of survey.
9. Introduction to various Softwares
10. Spot Speed Study Using Radar Speed Gun

TRAFFIC MODELLING DESIGN LAB

- Analysis and Modelling of Free-Flow Speed Distributions of Various Types of Vehicles.
- Analysis and Modelling of Speed for Free Flow in mid block section of highway
- Analysis of the time headway data for a given road section (intermediate flow).
- Analysis and modelling of the Time headway data (Congested Flow).
- Analysis of macroscopic relationship for a given road section.

TRAFFIC ANALYSIS

Module-I

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.

Module-II

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, Car-Following Theory.

Module-III

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.

Module-IV

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

Module-V

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

1. Review the concept of traffic flow
2. Use traffic surveys and generate traffic stream models
3. Design the links and intersections and queueing models
4. Evaluate safety into every aspect of design
5. Summarize the various warrants and their implimentations.

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**1**					
CO 2	**2**	**3**	**2**	**1**	**2**	
CO 3	**1**	**3**	**3**	**1**	**2**	
CO 4	**2**	**1**	**1**	**3**	**3**	
CO 5	**1**	**1**	**2**	**2**	**1**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	2	2	1	2	0

PAVEMENT ANALYSIS AND DESIGN

Module-I

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

Module-II

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

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

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.

Module-V

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

1. Review concepts of pavement stresses and performance.

2. Demonstrate and apply knowledge of the principles and practices of sustainable pavement design.
3. Solve complex theoretical and technical problems to design a pavement that meets given criteria and standards
4. Perform advanced analyses connected to material modelling and pavement design.
5. Evaluate structural condition of pavement

Course Articulation Matrix

Mapping	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	**3**	**1**			**2**	
CO 2			**2**			
CO 3				**3**		
CO 4	**3**	**3**	**1**		**1**	
CO 5			**1**		**1**	**3**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	1	1	1	1	1	1

HIGHWAY MATERIALS LAB

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, viscosity 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 Mix Design

Manual:

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

PAVEMENT DESIGN PRACTICE

- Design of flexible pavement IRC, AASHTO, Asphalt Institute method
- Design of rigid pavements IRC method, PCA and FAA method
- Design of overlay
- Application of software in pavement design
- Analysis and Identification of distresses in pavements.