BMS COLLEGE OF ENGINEERING, BENGALURU-19
(Autonomous Institute Affiliated to VTU)

SCHEME OF TEACHING AND EXAMINATION 2020-2022
M.Tech. Transportation Engineering and Management

BMS COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous College under VTU)

DEPARTMENT OF CIVIL ENGINEERING
SCHEME & SYLLABUS
FOR M.TECH PROGRAMME
IN
Transportation Engineering and Management
I to IV SEMESTER
(Admission Year: 2020 onwards)

BMS COLLEGE OF ENGINEERING

Bull Temple Road, Bengaluru - 560 019

BMS COLLEGE OF ENGINEERING, BENGALURU-19

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SCHEME OF TEACHING AND EXAMINATION 2020-2022

M.Tech. Transportation Engineering and Management

B.M.S COLLEGE OF ENGINEERING, BENGALURU-19

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DEPARTMENT OF CIVIL ENGINEERING

VISION OF INSTITUTE

Promoting prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

MISSION OF INSTITUTE

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society.

VISION OF THE DEPARTMENT

To be an excellent center for imparting quality higher education in Civil Engineering for a constantly changing societal needs with credibility, integrity and ethical standards.

MISSION OF THE DEPARTMENT

Accomplish excellence in curricular, co-curricular activities with a committed faculty through teaching and research which creates technically competent and dedicated civil engineers to serve their surroundings with pride.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

PEO1: Reveal essential knowledge and skills necessary for a professional career in Transportation Engineering and management.

PEO2: Demonstrate the analytical, quantitative and interpretative abilities required for the effective leadership in their chosen field.

PEO3: Exhibit the responsibility in a professional and ethical manner in their domain and continue career through lifelong learning to contribute to the societal needs.

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Programme Outcomes (POs):

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate mastery in the domain of the specialization of the program

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Percentage Credit Distribution

Sl. No.	Subject area	Percentage distribution of credits
1	Core Courses	31 (35 %)
2	Elective Courses	15 (17%)
3	Internship	10 (11 %)
4	Major Project	32 (36 %)

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I Semester **CREDIT BASED**

Course Type	Subject Code	Name of the Subject	CREDITS				Total CREDITS	Marks		
			L	T	P			CIE	SEE	Total
Programme Core-1	20CVTEPCTE	TRAFFIC ENGINEERING	3	1	-		4	50	50	100
Programme Core-2	20CVTEBSAS	APPLIED STATISTICS & PROBABILITY	3	1	-		4	50	50	100
Programme Core-3	20CVTEPCPM	PAVEMENT MATERIALS & CONSTRUCTION	3	1	-		4	50	50	100
Programme Elective-1 and 2	20CVTEPEAM	APPLIED SOIL MECHANICS	2	1	-		3	50	50	100
	20CVTEPETS	TRANSPORTATION STRUCTURES	3	-	-					
	20CVTEPEUT	URBAN PUBLIC TRANSPORT	3	-	-					
	20CVTEPETP	TRANSPORT PLANNING	3	-	-		3	50	50	100
	20CVTEPETY	TRANSPORTATION SYSTEMS	3	-	-					
	20CVTEPEOT	OPTIMIZATION TECHNIQUES	3	-	-					
	20CVTEPLAP	ADVANCED PAVEMENT MATERIALS LABORATORY	1	-	1		2	50	50	100
	20APRD1CRM	RESEARCH METHODOLOGY	2	-	-		2	50	50	100
	Total						22	350	350	700

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II Semester **CREDIT BASED**

Course Type	Subject Code	Name of the Subject	CREDITS				Total CREDITS	Marks		
			L	T	P	S		CIE	SEE	Total
Programme Core-4	**20CVTEPCAD**	ANALYSIS AND DESIGN OF PAVEMENTS	3	–	-		3	**50**	**50**	**100**
Programme Core-5	**20CVTEPCPE**	PAVEMENT EVALUATION AND MANAGEMENT	3	1	-		4	**50**	**50**	**100**
Programme Core-6	**20CVTEPCTF**	THEORIES OF TRAFFIC FLOW	3	-	-		3	**50**	**50**	**100**
Programme Electives – 3 and 4	**20CVTEPERS**	ROAD SAFETY AND MANAGEMENT	3	-	-		3	**50**	**50**	**100**
	20CVTEPEIT	INTELLIGENT TRANSPORTATION SYSTEMS	3	-	-					
	20CVTEPETR	TRANSPORT ECONOMICS	3	-	-					
	20CVTEPEGD	GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES	3	-	-		3	**50**	**50**	**100**
	20CVTEPEMM	TRANSPORTATION MODELING AND MANAGEMENT	3	-	-					
	20CVTEPLTC	TRANSPORTATION ENGINEERING COMPUTATIONAL LABORATORY	**1**	**1**	**-**		**2**	**50**	**50**	**100**
	20CVTEIEXX	ELECTIVE-V (INSTITUTIONAL)	4	-	-		4	**50**	**50**	**100**
	Total						**22**	**300**	**300**	**600**

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III Semester:

Course Type	Course Code	Course Title	Credits				MARKS		
			L	T	P	Total	CIE	SEE	Total
Programme Core-6	20CVTENTIT	Internship (12 Weeks)	-	-	10	10	50	50	100
Programme Core-7	20CVTEPJP1	Project –Phase I	-	-	12	12	50	50	100
Audit-1 (Non-Credit Mandatory Course)	20CVTENCM1	Audit Course – 1	2 units				-	-	-
	Total					22	100	100	200

IV Semester:

Course Type	Course Code	Course Title	Credits				MARKS		
			L	T	P	Total	CIE	SEE	Total
Programme Core-8	20CVTEPJP2	Major Project (Dissertation)	-	-	20	20	50	50	100
Programme Core-9	20CVTEPLTM	TRAFFIC MEASUREMENT LABORATORY	1	1	-	2	50	50	100
Audit-2 (Non-Credit Mandatory Course)	20CVTENCM2	Audit Course – 2	2 units				-	-	-
	Total					22	100	100	200

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Course Type	Code	Course Title	Credits				Total Credits	Marks		
			L	T	P	S		CIE	SEE	Total
Audit course-1 & 2	20CVCTNCEW	English for Research Paper Writing	-	-	-	-	-	--	--	--
	20CVCTNCPS	Pedagogy Studies	-	-	-	-	-	--	--	--
	20CVCTNCSM	Stress Management by Yoga	-	-	-	-	-	--	--	--
	20CVCTNCDM	Disaster Management	-	-	-	-	-	--	--	--

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SYLLABUS
I SEMESTER

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Course Type	Subject Code	Name of the Subject	CREDITS				Total CREDITS	Marks		
			L	T	P			CIE	SEE	Total
Programme Core-1	20CVTEPCTE	TRAFFIC ENGINEERING	3	1	-		4	50	50	100
Programme Core-2	20CVTEBSAS	APPLIED STATISTICS & PROBABILITY	3	1	-		4	50	50	100
Programme Core-3	20CVTEPCPM	PAVEMENT MATERIALS & CONSTRUCTION	3	1	-		4	50	50	100
Programme Elective-1 and 2	20CVTEPEAM	APPLIED SOIL MECHANICS	2	1	-		3	50	50	100
	20CVTEPETS	TRANSPORTATION STRUCTURES	3	-	-					
	20CVTEPEUT	URBAN PUBLIC TRANSPORT	3	-	-					
	20CVTEPETP	TRANSPORT PLANNING	3	-	-		3	50	50	100
	20CVTEPETY	TRANSPORTATION SYSTEMS	3	-	-					
	20CVTEPEOT	OPTIMIZATION TECHNIQUES	3	-	-					
	20CVTEPLAP	ADVANCED PAVEMENT MATERIALS LABORATORY	1	-	1		2	50	50	100
	20APRD1CRM	RESEARCH METHODOLOGY	2	-	-		2	50	50	100
	Total						22	350	350	700

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Course Name	**TRAFFIC ENGINEERING**	**Course Code**	**20CVTEPCTE**	**SEE Duration**	**03 Hrs**
Credits	**04**	**L-T-P-S**	**3-1-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course students should be able to

Conceptualize/visualize the road traffic in terms of fundamental traffic flow parameters and measure them on the field.

Analyze and evaluate the performance of interrupted and uninterrupted transport facilities based on appropriate measures of effectiveness.

Unit 1

Introduction to Traffic Engineering: Road user characteristics; human and vehicle characteristics, fundamental parameters and relations of traffic flow. – speed, density, volume, travel time, headway, spacing, time-space diagram, TMS and SMS.

Unit 2

Traffic measurement procedures: Measurement at a point – traffic volume, data analysis, Concepts of ADT and AADT, Measurement over a short section – percentile speeds, design speed and speed distributions, Measurement along a length of a road – density and travel time measurement, automated measurement – GPS, loop detectors, video analysis**,** moving observer method.

Unit 3

Capacity analysis and LOS determination for uninterrupted facilities: Definitions – Highway capacity, factors affecting LOS, HCM methods – Urban street, Two-lane and Multilane highways, Freeway segments.

Unit 4

Traffic Intersection control: Principles of traffic control, uncontrolled intersection – LOS, critical gap and follow-up time, capacity, queue length, control delay; Grade separated intersection.

Unit 5

Traffic Signal design: Elements of traffic signal, Design principles of a traffic signal – Webster and IRC methods, Evaluation of traffic signals – Delay models, Capacity and LOS of a signalized intersection.

REFERENCES:

NPTEL course on Traffic Engineering & Management by Dr. Tom V. Mathews, IIT Bombay.

Roess, RP., McShane, WR. and Prassas, ES. (1998), Traffic Engineering, Prentice Hall.

Papacostas, C. S. (1987), Fundamentals of Transportation Engineering, Prentice Hall.

Kadiyali, LR (1987), Traffic Engineering and Transportation Planning, Khanna.
Highway Capacity Manual (2000), Transportation Research Board, USA.
Khanna, S. K. and Justo, C. E. G. (1991), Highway Engineering, Nemchand.
Pingnataro, G. J. (1970), Principles of Traffic Engineering, Mc Graw - Hill.
IRC Codes.

Course Name	**TRANSPORT PLANNING**	**Course Code**	**20CVTEPETP**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P**	**3-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Estimate travel demand for urban settlements

Prepare demand distribution models (gravity models) and modal split models for mode choice analysis.

Develop and calibrate trip generation rates for specific types of land use developments.

Unit 1

Land use and Transportation System: Introduction-Urban system Components-Concepts and definitions-Criteria for measuring urban sprawl— Location theory-urban growth or decline

Unit 2

Transportation Planning Process: Introduction-Definition-Factors to be considered; Land use transportation planning; systems approach-Stages-Inventory of Existing Conditions-Difficulties in implementation.

Unit 3

Transport Surveys: Basic Movements- Study Area-Zones--Origin-Destination survey Objectives- Different types of Transportation surveys and interpretation

Unit 3

Trip Generation and Distribution: Factors governing trip generation and attraction – Application of Regression Analysis- Methods of trip distribution; Growth and Synthetic Models-Calibration and Application of gravity model.-Category analysis. Problems

Unit 4

Modal Split and Assignment: Factors affecting modal split; Modal split in transport planning; Principles of traffic assignment; assignment techniques. Problems

Unit 5

Land Use Models – Lowry Model-Hansen's Accessibility Model-Density-Saturation Gradient Model-Problems (Except on Lowry Model)

Mass Transit Systems: Types- Capacity, Fleet planning and Scheduling.

REFERENCES:

Kadiyali, L. R., `Traffic Engineering and Transportation Planning' - Khanna Publication, New Delhi, 2009

Jotin Khisty and B. Kent Lall "Transportation Engineering –An Introduction- PHI, New Delhi, 3rd Indian Edition, 2006.

James H Banks – "Introduction to Transportation Engineering, TMH, New Delhi 2011

Institute of Traffic Engineers - An Introduction to Highway Transportation Engineering 'New York., 1982

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Course Name	**PAVEMENT MATERIALS & CONSTRUCTION**	**Course Code**	**20CVTEPCPM**	**SEE Duration**	**03 Hrs**
Credits	**04**	**L-T-P-S**	**3-1-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be

Able to acquire and apply knowledge of properties of road aggregates and binders in conducting various laboratory tests.
Qualified to design bituminous mix with Rothfutch method considering the required specifications.
Understand the application of various equipment used for road construction
Able to understand Technology and the construction process of Bituminous and Cement-Concrete roads

Part A: Pavement Materials

Unit 1

Aggregates: Origin, classification, requirements, properties and tests on road aggregates, concepts of size and gradation - design gradation, maximum aggregate size, aggregate blending to meet specification.

Bitumen and Modified Bitumen: Origin, preparation, properties and chemical constitution of bituminous road binders; requirements.

Unit 2

Bituminous Emulsions and Cutbacks and Tar: Preparation, characteristics, uses and tests.

Adhesion of Bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion.

Unit 3

Bituminous Mixes: Introduction-Various types of bituminous mixes- Mechanical properties, dense and open textured mixes, flexibility and brittleness, (No Hveem Stabilometer & Hubbard-Field Tests) bituminous mix, design methods using Rothfuch's Method only and specification using different criteria - The Marshall Stability Analysis of Bituminous Mixture- voids in mineral aggregates, voids in total mix, bulk density, percentage voids filled with bitumen, stability, and flow- Introduction to Superpave mix design method.

Smart Materials : warm mix asphalt.

Part B: Pavement Construction

Unit 4

Equipment in Highway Construction: Various types of equipment for excavation, grading and compaction - their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction.

Unit 5

Subgrade: Preparation of subgrade- construction of embankments and cuts for roads; Quality control tests.

Flexible Pavements: Specifications of materials, construction method and field control checks for of flexible pavement layers –BM- DBM and BC

Cement Concrete Pavements: – PQC-FRCC- Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints.

REFERENCES:

RRL, DSIR, `Bituminous Materials in Road Construction', HMSO Publication
RRL, DSIR, `Soil Mechanics for Road Engineers', HMSO Publication
Khanna, S.K., and Justo, C.E.G., `Highway Engineering', Nem Chand and Bros. Roorkee
Sharma, S.C., `Construction Equipment and its Management', Khanna Publishers
Relevant IRC Codes & MoRT&H Specifications for Roads and Bridge Works, 2013 (5^{th} Edition)
Pritvi Singh Kandhal, BITUMINOUS ROAD CONSTRUCTION IN INDIA,2020, PHI, New Delhi
7. Rajib B. Mallick and Tahar El-Korchi, PAVEMENT ENGINEERING, Principles and Practice, CRC Publication, NewYork. 2015

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Course Name	**APPLIED SOIL MECHANICS**	**Course Code**	**20CVTEPEAM**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-**	**2-1-0**	**CIE+SEE**	**50+50**

COURSE OBJECTIVE: To gain knowledge about assessing suitability of soil as a subgrade or as a material for construction of roads and embankments.

COURSE OUTCOME:
An ability to :

CO1 : Identify and classify soil.
CO2 : Demonstrate knowledge of evaluating their suitability and suggest soil strength improvement techniques for road construction.

Unit 1

Introduction: Soil Mechanics applications to Highway Engg. Soil formations, Types, Regional Soil deposits of India, list of Index properties, numericals on field density, grain size, Atterberg limit, their desirable limits from IRC codes, soil classification systems- IS, HRB classification, problems on classification of soils.
7 hours

Unit 2
Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure &Engg behavior of compacted soil, Application : Field compaction specifications Filed compaction control, Different types of Equipment used for compaction, their choice, Numericals – compaction, volume of soil excavation from borrow pit
8 hours

Unit 3
Shear strength of soil: Introduction, types of shear tests, drainage conditions, numericals importance of unconfined compressive strength of clays in construction of roads, Application of shear parameters in slope stability- method of slices. **7 hours**

Unit 4

Permeability of soil: Introduction, Darcy's Law, Validity, Factors affecting, Determination of permeability –constant head and falling head methods, pumping –out tests, , problems. Application of permeability in roads : Types of highway drainage, sub surface drainage methods, Road construction in water logged areas, landslides-Causes and effects.

Unit 5
7hours

Soil stabilization: Introduction, purpose, types- lime, cement, case studies of road construction.

Reinforced Earth Structures: Introduction, Components, Advantages, Types of stability – external, Internal,, Geosynthetics- Types, Functions, their uses in road embankments and railway works, and other uses.

7 hours

REFERENCES:

Basic and Applied soil Mechanics, Gopal Ranjan, ASR Rao, New Age International Publishers.
Soil Mechanics & Foundation Engg, Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 18th edition.
Highway Engg, S.K. Khanna, C.E.G. Justo, 5th edition.
Soil Mechanics & Foundation Engg – K.R. Arora Standard Publishers Distributors.
Soil Mechanics for road Engineers – HMSO, London.
Soil Reinforcement and geosynthetics by Dr. G.L. Sivakumar babu, Universities press (india) Pvt Ltd,
Relevant IRC – Codes

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Course Name	**TRANSPORTATION STRUCTURES**	**Course Code**	**20CVTEPETS**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Decide the selection of transportation structures, list the factors affecting design of various transportation structures and generate the input parameters required for design.

Summarize the design methodology and arrive at design values for various transportation structures.

Unit **1**

Introduction: Principles of Planning of Elevated Rail Transit System, grade separation structures, pedestrian crossing and sub- ways.

Unit **2**

Loads on Bridges: Dead loads, live loads, dynamic effects of vehicles, longitudinal forces, centrifugal forces, wind loads, earth quake forces, stream flow pressure, load combinations, design examples.

Unit **3**

Design of Bridge Slabs: Longitudinally reinforced deck slabs, transversely reinforced bridge slabs.

Unit 4

Design of Reinforced Concrete Bridges: Design procedures for T- beam, box girder bridges design examples.

Unit 5

Design of Pre-stressed Concrete Bridges: Design code, design examples.

Segmental Box bridges - precast sections, criteria, design examples

Sub-Structure Design: Foundation investigation, bearings, bridge pier design, and abutment design, Examples.

REFERENCES:

Raina, R. K, 'Principles of Design of RCC Bridges, Tata McGraw Hill,1999.
Krishnaraju‘ Bridge Engineering‘, UPD Publishers, New Delhi,2000.
Conrad P. Heins and Richard A. Lawrie, `Design of Modern Concrete Highway Bridges, JohnWileyandSons,1999.
Baider Bakht and Leslie, G. Jaeger, `Bridge Analysis Simplified, McGrawHillBookCo,1998.
Johnson Victor, `Bridge Engineering', Oxford IBH, NewDelhi,2000
Relevant IRC and BIS Codes

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Course Name	URBAN PUBLIC TRANSPORT	Course Code	20CVTEPEUT	SEE Duration	03 Hrs
Credits	03	L-T-P	3-0-0-0	CIE+SEE	50+50

COURSE OUTCOMES:

After the completion of the course the student should be

Able to remember transit modes, management activities and demand analysis.
Capable of selecting different demand management techniques, intersection management techniques and small area management.

Unit **1**

System and Technologies: Urban passenger transportation modes, transit classifications and definitions, theory of urban passenger transport modes, rail transit, bus transit, Para transit and ride sharing, designing for pedestrians, trends in transit rider ship and use of different modes.

Unit **2**

Comparing Alternatives: Comparing costs, comparative analysis, operational and technological characteristics of different rapid transit modes, evaluating rapid transit

Unit 3

Planning: Transportation system management, system and service planning, financing public transportation, management of public transportation, public transportation marketing.

Unit **4**

Transit System Evaluation: Definition of quantitative performance attributes, transit lane capacity, way capacity, station capacity, theoretical and practical capacities of major transit modes, quantification of performance

Unit **5**

City Traffic: Classification of transportation systems, conventional transportation systems, unconventional transportation systems, prototypes and tomorrow's solutions, analysis and interpretation of information on transportation systems, perspectives of future transportation.

REFERENCES:

1. George E. Gray and Lester A. Hoel. “Public Transportation”, Prentice Hall, New Jersey.
2. Vukan R Vuchic, “Urban Public Transportation Systems and Technology”, Prentice Hall Inc., New Jersey
3. Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss,' City Traffic - A Systems Digest', Van Nostrand Reinhold Company, New York

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Course Name	**APPLIED STATISTICS AND PROBABILITY**	**Course Code**	**20CVTEBSAS**	**SEE Duration**	**03 Hrs**
Credits	**04**	**L-T-P**	**3-1-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course students should be

Able to conceptualize and identify real world events as a function of discrete/continuous distributions and characterize them using parameters like moments, PDF and CDF.
Able to study relationships between various factors using Regression analysis and test the validity of these relationships using statistical decision making tools like hypothesis testing.

Unit **1**

Fundamentals of probability: Classification of data – Nominal, ordinal, interval ratio, count, Mean, variance, skewness, kurtosis, Graphical description – area, pie, bar, line, scatter charts, Boxplots – quartiles and percentiles. Random experiments, Sample space, events, Concepts of probability, Axioms of probability, important theorems on probability.

Unit **2**

Random variables: Discrete and continuous random variables, Probability Mass Function, Probability Density Function and Cumulative Density Function, Conditional, marginal and joint probability, Bayer's rule, Combinatorial analysis.

Unit **3**

Types of distributions: Discrete distributions – Bernoulli, binomial, multinomial, geometric, negative binomial, Poisson distribution, Continuous distributions – uniform, Exponential, Gamma, normal distributions. Functions of random variables, random variable generation – discrete and continuous using Monte Carlo method.

Unit **4**

Hypothesis testing: Principle of hypothesis testing, Sample and population, Confidence interval, level of significance, Power of a test, Central limit theorem, One-sample tests – Mean test and variance test, Type-I & II errors, Two-sample tests – Independent and paired sample tests, test for correlation, Test for distributions – Chi-squared test, KS or AD test.

Unit **5**

Regression: Simple linear regression models, multiple linear regression models – Interpretation of coefficients, F-test for overall goodness-of-fit of the model, assumptions in linear regression model, and Regression F tests for comparison of models.

REFERENCES:

Bilal M. Ayyub. Richard H. McCuen. Probability, Statistics, and reliability for Engineers and Scientists. CRC Press. Taylor and Francis Group, 3rd edition.

Kumar Moluguram and G. Shanker Rao. Statistical Techniques for Transportation Engineering. BS Publications.
Gupta, S.C. and Kapoor V.K. Fundamentals of Mathematical statistics, Sultan Chand and Sons, 1978.
Medhi J (1982) Introduction to statistics. New age publications, New Delhi.
Walpole R. E. and R. H. Mayers (1982): Probability and statistics for Engineers and Scientists. Wiley Intl. 2002.
Johnson R and G. Bhattacharya (1985): Statistics – principles and methods. John Wiley, N Y.
Ross S. M. Probability and statistics for Engineers. Wiley Int. Edition.

Course Name	**TRANSPORTATION SYSTEMS**	**Course Code**	**20CVTEPETS**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course students should be able

To list the various surveys required for traffic management

To identify transportation problem at a given site, analyze the survey data and synthesize efficient traffic management measures

Unit 1

Methodology & Data Collection: Methodological frame work, objectives and problems, conflicts resolution, strategic categories and action elements, travel behaviour impact and response time.

Unit 2

Traaffic System Management (TSM) Actions, Combination of Interaction: Impact assessment and evaluation, monitoring and surveillance, Area wide data collection methodology, corridor data collection methodology.

Unit 3

Public transportation & HOV treatment: Toll discounts for car pools during peak periods, park and ride, carpooling, exclusive lanes, priority at ramp terminals, bus transfer stations, limited and skip-stop bus services, shared ride.

Unit 4

Traffic Operations Improvement: On-street parking ban, freeway ramp control &closure, travel on shoulders, one-way-streets, reversible lanes, traffic calming, Right turn phase, right turn lanes, reroute turning traffic.

Unit 5

Parking Management: Short term reserved parking, increased parking rates, time duration limits, expanded-off-street parking, Non-Motorized Transport- pedestrian only streets, Dial-a-ride for elderly & handicapped.

TEXT BOOKS:

1. Khisty, C. J, and Lall, B. K., Transportation Engineering: An Introduction, Prentice Hall International, Inc., 2010
2. C. S. Papacostas, Fundamentals of Transportation System Analysis, PHI.

REFERENCES:

1. Institution of Transportation Engineers, Traffic Engineering Hand Book, 4th Edition, Prentice
Hall, 1999.
2. Transportation System Management, State of the Art, UMTA, USDOT, 2008
3. TRB Publications.

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Course Name	**OPTIMIZATION TECHNIQUES**	**Course Code**	**20CVTEPEOT**	**SEE Duration**	**03 Hrs**
Credits	**3**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:
The student will be able to **:**

Use effectively the different optimization techniques and apply to the appropriate engineering problems.

Encounter, study and solve optimization problems.

Unit 1

Introduction to Optimization: Introduction - Historical developments - Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization problems - Optimization Techniques. Optimization by calculus: Introduction - Unconstrained functions of a single variable - Problems involving simple constraints - Unconstrained functions of several variables – treatment of equality constraints - Extension to multiple equality constraints – Optimization with inequality constraints - The generalized Newton-Raphson method.

Unit 2

Linear Programming: Introduction - Applications of linear Programming - standard form of a linear Programming problem - Geometry of linear Programming problems - Definitions and theorems - Solution of a system of Linear simultaneous equations - Pivotal reduction of a general system of equations - Motivation of the Simplex Method - Simplex Algorithm - Two phases of the simplex method.

Unit 3

Non-Linear Programming: Introduction - Unimodal Function - Unrestricted search – Exhaustive search - Dichotomous search - Interval Halving method - Fibonacci method - Golden section method - Comparison of elimination methods - Unconstrained optimization techniques – Direct search methods - Random search methods - grid search method - Univariate method - Powell's method - Simplex method - Indirect search methods - Gradient of a function - Steepest descent method - Conjugate gradient - Newton's method.

Unit **4**

Dynamic Programming: Introduction - Multistage decision processes - concept of sub-optimization and the principle of optimality - computational procedure in dynamic Programming - example illustrating the Calculus method of solution - example illustrating the

Tabular of solution - conversion of a final value problem into an initial value problem - continuous dynamic Programming - Additional applications.

Unit **5**

Network Analysis: Introduction - Elementary graph theory - Network variables and problem types Minimum-cost route - Network capacity problems - Modification of the directional sense of the network, Application of Optimization Techniques.

REFERENCES:

1. Optimization: Theory and Applications by S.S. Rao. New Age International (p) Ltd.
2. Numerical Optimization Techniques for Engineering Design with applications by G.N.Vanderplaats 2007.
3. Elements of Structural Optimization by R.T. Haftka and Z. Gurdal Kluwer academic publishers.
4. Optimum Structural Design by U.Kirsch. Tata Mc Graw Hill. New York , 2014
5. Optimum Design of Structures by K.I. Majid, PHI, New Delhi, 2014

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Course Name	**ADVANCED PAVEMENT MATERIALS LAB**	**Course Code**	**20CVTEPLAP**	**SEE Duration**	**03 Hrs**
Credits	**02**	**L-T-P-S**	**1-0-2-0**	**CIE+SEE**	**25+50**

COURSE OUTCOMES:

After the completion of the course the student should be :

Able to test the aggregates and bitumen for different properties
Qualified to design bituminous mix Rothfutch method of marshal mix design
Able to analyze the properties of cement and do concrete mix design.

Unit 1

Coarse Aggregate: Gradation- Routhfutch Method- Shape tests-Aggregate Impact Test- Los Angeles Abrasion Test – Compressive strength of Aggregates- Specific Gravity Test and Water Absorption Test

Unit 2

Bitumen: Penetration Test-Ductility Test- Softening point Test-Flash and Fire Point Test-Viscosity test- Stripping Test- Thin Film Oven Test- Marshall Stability Mix Design-Analysis- Inter pretation of Graphs

Unit 3

Cement Concrete: Cement Concrete Mix Design-Tests on FRC and PQC

Unit 4

Soil Mechanics: Identification of Soil type **:**Basic Tests-Gradation-dry and wet-Hydrometer Analysis- Attenberg Limits- Sp.Gr Test-Bulk Density- Compaction Test Sand Replacement Method-Core Cutter method –

Unit 5

Triaxial and Shear Test- CBR Test

REFERENCES:

Highway Material Testing – S K Khanna- C.E.G. Justo and A. Veeraragavan , Nemchand Bros- Rookee, 2012.
Relevant IS and IRC Code

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SYLLABUS
II SEMESTER

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Course Type	Subject Code	Name of the Subject	CREDITS				Total CREDITS	Marks		
			L	T	P	S		CIE	SEE	Total
Programme Core-4	**20CVTEPCAD**	ANALYSIS AND DESIGN OF PAVEMENTS	3	-	-		3	**50**	**50**	**100**
Programme Core-5	**20CVTEPCPE**	PAVEMENT EVALUATION AND MANAGEMENT	3	0	1		4	**50**	**50**	**100**
Programme Core-6	**20CVTEPCTF**	THEORIES OF TRAFFIC FLOW	3	-	-		3	**50**	**50**	**100**
Programme Electives – 3 and 4	**20CVTEPERS**	ROAD SAFETY AND MANAGEMENT	3	-	-		3	**50**	**50**	**100**
	20CVTEPEIT	INTELLIGENT TRANSPORTATION SYSTEMS	3	-	-					
	20CVTEPETR	TRANSPORT ECONOMICS	3	-	-					
	20CVTEPEGD	GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES	3	-	-		3	**50**	**50**	**100**
	20CVTEPEMM	TRANSPORTATION MODELING AND MANAGEMENT	3	-	-					
	20CVTEPLTC	TRANSPORTATION ENGINEERING COMPUTATIONAL LABORATORY	**1**	**1**	**-**		**2**	**50**	**50**	**100**
	20CVTEIEXX	ELECTIVE-V (INSTITUTIONAL)	4	-	-		4	**50**	**50**	**100**
	Total						**22**	**300**	**300**	**600**

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Course Name	**ANALYSIS AND DESIGN OF PAVEMENTS**	**Course Code**	**20CVTEPCAD**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

List and explain the various factors affecting design and performance of pavements.
Design flexible and rigid pavements.
Understand importance and design concepts of providing Rural Roads

Unit 1

Introduction: Introduction-Highway and airport pavements, Types and component parts of pavements, their differences - Factors affecting design and performance of pavements.

Unit 2

Stresses and Deflections In Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister's two-layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL and EWL factors. Pavement behavior under transient traffic loads. Problems on above

Unit 3

Flexible Pavement Design Methods For Highways: Introduction-Different Methods- CBR method-Principle –Testing as per IRC, AASHTO and Asphalt Institute and Shell Method.- Overlay designs- Benkelman deflection study - Problems on above

Unit 4

Stresses in Rigid Pavements: Introduction-Factors affecting design and performance of pavements-Important Definitions- Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL, wheel load stresses, warping stresses, frictional stresses, combined stresses. Problems on above

Unit 5

Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacing; design of CC pavement for roads and runways, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements, Problems on above

REFERENCES:

Yoder, E.J., and Witczak, Principles of Pavement Design, 2nd ed. John Wiley and Sons, 1975.
Yang, Design of Functional Pavements, McGraw Hill Book Co.
Khanna and Justo, Test Book of Highway Engineering, Nemchand brothers, Roorke-2004.
Huang, Pavement Analysis, Elsevier Publications
HMSO, Soil Mechanics for Road Engineers, Her Majesty's Stationary Office, London.
Manual for Rural Roads- IRC Publication
IRC, Codes and Special Publications
PIARC, International Road Maintenance Hand Book –Maintenance of Paved Roads, France.
PIARC, International Road Maintenance hand Book –Maintenance of Unpaved Roads,
HRB/TRB/IRC/International Conference on Structural Design of Asphalt Pavements.
CMA Hand Book

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Course Name	**PAVEMENT EVALUATION AND MANAGEMENT**	**Course Code**	**20CVTEPCPM**	**SEE Duration**	**03 Hrs**
Credits	**04**	**L-T-P-S**	**3-0-1-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Identify the factors influencing performance of pavements
Carry out structural and functional evaluation of pavements
Explain the use of models for pavement management
Develop a framework for efficient pavement management system

PAVEMENT EVALUATION

Unit 1

Introduction: Structural and functional requirements of flexible and rigid pavements; pavement distress; different types of failures, causes .

Evaluation of Surface Condition: 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.

PAVEMENT MANAGEMENT

Unit 2

Introduction: Definition -Components of Pavement Management Systems, Essential features.
Pavement Management Levels and functions: Ideal PMS- Network and Project levels of PMS-Influence Levels- PMS Functions- Function of Pavement evaluation.

Unit 3

Pavement Performance: Serviceability Concept- Development of Serviceability Index-PSI-RCI- Roughness- Roughness Components- Evaluation-Equipment- Universal Roughness standard-Techniques-IRI – Application of Roughness Data in Network level and Project Level.

Unit 4

Evaluation of Pavement Structural capacity: Basics- NDT and Analysis—Condition Surveys- Distress-Destructive Structural Analysis- Application in Network and Project Levels-Methods and Equipment- Combined Measures of Pavement Quality-Concept-Methods of developing a combined index-limitations.

Establishing Criteria: Need- Characteristics- effect of changing criteria- examples- Prediction models for pavement deterioration-Need-measures to be predicted-requirements- Basic types of Prediction Models-

Unit 5

Expert Systems and Pavement Management: Applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge-based expert systems, case studies.

REFERENCES:

Yoder, E.J., and Witczak, Principles of Pavement Design, 2nd ed. John Wiley and Sons, 1975.
Yang, Design of Functional Pavements, McGraw Hill Book Co.
Khanna and Justo, Test Book of Highway Engineering, Nemchand brothers, Roorke-2011
Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co. 1978.
Ralph Haas, Ronald Hudson Zanieswki. Modern Pavement Management, Kreiger Publications, New York, 1992.
Proceedings of North American Conference on Managing Pavement, USA, 2004.
Proceedings of International Conference on Structural Design of Asphalt Pavements
NCHRP, TRR and TRB Special Reports, USA, 2006.

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Course Name	**TRANSPORT ECONOMICS**	**Course Code**	**20CVTEPETR**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Able to apply the concepts and tools of microeconomics.
Able to understand basic concepts of economic analysis.
Understand Economic theory as applied to transport, including demand, supply and pricing theory and practice.

Unit 1

Introduction: Concepts and Principles of Engineering Economics, Identification and Measurements of Highway Benefits, Highway Transportation Costs, Road User Costs and Benefits- Introduction to PPP - Concepts of BOO, BOT, BOOT, Road User Cost Study in India.

Unit 2

Methods of Economic Analysis: Basic formulas-Methods- BCR-NPV-IRR –Their Basic Characteristics, Illustrative applications on above Methods of Economic Analysis, Comparison of the Methods of Analysis-

Unit 3

Evaluation of Engineering Alternatives-Present Worth Method –Future Worth Method-Characteristics and Limitations of the Different Methods of Economic Analysis, Problems on above. Break Even Analysis-Sensitivity Analysis. Case studies and problems.

Unit 4

Depreciation Concepts: Depreciation Cost, accounting Methods, Salvage Value Estimation, Depreciation, Problems.

Unit 5

Supply and Demand: Concept-Definition-Factors affecting Demand and Supply- Shift in Demand and Supply- Transportation demand Model- Equilibrium-Sensitivity of Travel Demand- Elasticities –determination of Elasticity from regression analysis -Consumer Surplus-Marginal Cost-Average Cost- Pricing- Concept of Road Prising-Problems.

REFERENCES:

REFERENCE BOOKS:

1. R. Paneer Selvam “Engineering Economics”PHI Learning Pvt. Ltd., New Delhi 2013

2. Jotin Khisty and Kent Lall, 'Introduction to Transportation Engineering' PHI, New Delhi,2010
3. Kadiyali.L.R.' Traffic Engineering and Transport planning', Khanna Publications, New Delhi, 2000.
4. Relevant IRC Codes and Practices
5. James L Riggs, 'Engineering Economics' 4 th Edition, Tata McGrawhill, New Delhi, 2010.
6. Prasanna Chandra, 'Financial Management' 5 thEdition,Tata McGrawhill, New Delhi, 2012

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Course Name	**INTELLIGENT TRANSPORTATION SYSTEMS**	**Course Code**	**20CVTEPEIT**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Able to appreciate the advantages of ITS and suggest the appropriate technologies for field conditions.

Able to suggest the appropriate system/s in various functional areas of transportation.

Able to amalgamate the various systems, plan and implement the applications of ITS.

Unit 1

Introduction to Intelligent Transportation Systems (ITS): Definition, Objectives, Historical Background, Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection**.**

Unit 2

Telecommunications in ITS: Information Management, Traffic Management Centres (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts.

Unit 3

ITS functional areas: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

Unit 4

ITS Operations: 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 Programme, research, development and business models, ITS planning

Unit 5

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 ; public transportation applications; Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries. [Case study]

REFERENCES:

Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House.
Kan Paul Chen, John Miles, "Recommendations for World Road Association (PIARC)" ITS Hand Book 2000.
Sussman, J. M., "Perspective on ITS", Artech House Publishers, 2005.
US Department of Transportation, "National ITS Architecture Documentation", 2007 (CD- ROM).
Turban. E and Aronson. J. E, "Decision Support Systems and Intelligent Systems", Prentice Hall

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Course Name	ROAD SAFETY AND MANAGEMENT	Course Code	20CVTEPERS	SEE Duration	03 Hrs
Credits	03	L-T-P-S	3-0-0-0	CIE+SEE	50+50

COURSE OUTCOMES:

After the completion of the course the student should be able to

Able to acquire knowledge statistical methods and computer application of accident analysis.
Able to remember the process of road safety audit and the measures of improving road safety.
Qualified to evaluate the effectiveness of various management techniques adopted in reducing road accident.

Unit 1

Road accidents, Causes, Scientific Investigations and Data Collection: Analysis of Individual Accidents to Arrive at Real Causes; Statistical Methods of Analysis of Accident Data, Application of Computer Analysis of Accident Data.

Unit **2**

Ensuring Traffic Safety in Designing New Roads: Ways of Ensuring Traffic Safety in Road Design considering the Features of Vehicle Fleet, Psychological Features of Drivers, Natural and Meteorological Conditions, Structure of Traffic Streams, Orientation of a Driver on the Direction of a Road beyond the Limits of Actual Visibility and Roadway Cross Section & Objects on the Right-of-Way.

Unit 3

Ensuring Traffic Safety in Road Reconstruction: Road Reconstruction and Traffic Safety, Reconstruction Principles, Plotting of Speed Diagram for Working out Reconstruction Projects, Use of Accident Data in Planning Reconstruction of Roads, Examples of Reconstruction of Selected Road Sections for Improving Traffic Safety, Improving Traffic Conditions on Grades, Sharp Curves, Redesign of Intersections, Channelized At-Grade Intersections, Bus Stops, Parking & Rest Areas and Effectiveness of Minor Road Improvements.

Unit 4

Ensuring Traffic Safety in Road Operation: Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.

Unit 5

Road Safety Audit: Principles- Procedures and Practice, Code of Good Practice and Checklists. Road Safety Issues and Various Measures through Engineering, education and enforcement measures for improving road safety.

Traffic Management Techniques: Local area management. Transportation system management. Low cost measures, area traffic control. Various types of medium and long term traffic management measures and their uses. Evaluation of the effectiveness and benefits of different traffic management measures, management and safety practices during road works. Economic evaluation of improvement measures by "before and after studies" - Case studies.

REFERENCES:

BABKOV, V.F. Road conditions and Traffic Safety, MIR, publications, Mascow - 1975.
K.W. Ogden, Safer Roads – A Guide to Road Safety Engg. Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publications, New Delhi, 2009.
C. Jotin Kishty& B. Kent Lall, Transportation Engineering-An Introduction, Thrid Edition, Prentice Hall of India Private Limited, New Delhi, 2006
Latest Editions of Relevant Indian Roads Congress (IRC) Publications for Design of Roads and Road Safety.
Khanna and Justo, Text book of Highway Engineering, Nemchand Brothers, Roorkee, 2001.

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Course Name	**GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES**	**Course Code**	**20CVTEPEGD**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Design the geometric elements of horizontal and vertical alignment
Design the geometric elements of cross-section, rural and urban arterials and intersections.

Unit 1

Introduction: Classification of rural highways and urban roads. Objectives and requirements of highway geometric design. Design Control and Criteria. Design Elements - Sight distances - types, analysis, factors affecting, and measurements.

Unit 2

Horizontal alignment: - design considerations, stability at curves, superelevation, widening, transition curves; curvature at intersections, Problems.

Unit 3

Vertical alignment: - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design. Problems.

Unit 4

Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness.

Unit 5

Design Considerations: Design considerations for rural and urban arterials, freeways, and other rural and urban roads - design speeds, volumes, levels of service and other design considerations. Design Of Intersections: Characteristics and design considerations of at-grade intersections; Different types of islands, channelization; median openings; Rotary intersections; Grade separations and interchanges - types, warrants, adaptability and design details; Interchanges - different types, ramps. Computer applications for intersection and interchange design.

REFERENCES:

AASHO, "A Policy on Geometric Design of Highways and Streets', American Association of State Highway and Transportation Officials, Washington D.C.
Khanna S.K. and Justo, C. E. G. `Highway Engineering', Nem Chand and Bros.,2000.
DSIR, `Roads in Urban Areas', HMSO, London.
Jack E Leish and Associates, `Planning and Design Guide: At-Grade Intersections'. Illinios.
Relevant IRC Codes & Publications.

Course Name	**TRANSPORTATION MODELING AND MANAGEMENT**	**Course Code**	**20CVTEPEMM**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Able to have the knowledge in system Dynamics of simulation
Able to generate Transportation Models

Unit 1

Systems Approach Concept: System – Concepts, Theories – Classification – Models – Concept of Modeling exercises – Phases in model building process – System Approach – System Dynamics (S.D) View Points – Physical Flow – Information Flow.

Unit 2

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 – Principles of Systems and its Hierarchies.

Unit 3

Model Development And Scenario Analysis: System Dynamic Model Development - Flow Diagraming methodologies – Stocks and Rate Variable Concepts – Relevance of selection in Level and other auxiliary variables – Significance of Sensitivity Analysis in Simulation Modeling – Importance of Policy and Scenario Analysis.

Unit 4

Model Verification And Validation: Concepts of Model Verification – Model Calibration – Model Validation - Sensitivity and Dimensional Analysis – Methods of SD Model Validation – Comparison of Conventional Model Validation with Simulation Model Validation efforts.

Unit 5

Modeling Transportation Systems: Conventional Modeling – Computer Simulation Modeling efforts – Application to Traffic and Transportation Systems – Modeling of any traffic systems for service quality enhancement – Modeling of transport, energy and environment system interactions.

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", 3rd 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

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Course Name	THEORIES OF TRAFFIC FLOW	Course Code	20CVTEPETF	SEE Duration	03 Hrs
Credits	03	L-T-P-S	3-0-0-0	CIE+SEE	50+50

COURSE OUTCOMES:

After the completion of the course the student should be able to

Analyze and apply microscopic and macroscopic traffic flow models using empirically collected traffic flow data

Apply queuing theory in formulating and solving problems related to real world queuing systems

Unit 1

Traffic Stream Parameters: Macro and microscopic traffic parameters – Speed, Density, flow, TMS, SMS, Equations of traffic flow, Time-space diagram,

Unit 2

Macroscopic Traffic flow models: Macroscopic traffic flow models, Empirical and Theoretical traffic flow models – Greenshield, Greenberg, Northwestern, Underwood models, Single regime and multi regime models.

Unit 3

Microscopic traffic flow model : Car following model, Pipes model, Forbes model, Response stimulus models, Car following simulation, Vehicle arrival models, Optimal target velocity model, Psycho physical model, Stability analysis, Fluid flow models.

Unit 4

Differential equations in traffic flow: Continuity equations, Partial differential equations (PDE) of traffic flow – Solving Linear PDE, Solving non-linear PDE, Shockwaves and its application.

Unit 5

Queuing theory: Incident analysis, Probabilistic analysis of traffic flows, Gap acceptance models, Random queuing systems, Analysis of MM1 queues.

REFERENCES:

1. Drew, D.R., Traffic Flow Theory and Control, McGraw Hill., 1978.
2. Adolf D. May, Traffic flow fundamentals,
3. TRB, Traffic Flow Theory - A Monograph, SR165, 1975.

4. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems,
Oxford Publication, 2004.
5. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.

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Institutional Elective :
ELECTIVE-V (INSTITUTIONAL)

Course Name	**Construction Planning, Equipment & Management**	**Course Code**	**20CVTEIECM**	**SEE Duration**	**03 Hrs**
Credits	**03**	**L-T-P-S**	**3-0-0-0**	**CIE+SEE**	**50+50**

Cos :

Understand the highway planning process and difficulties or failures associated with planning process.

Understands the cost of materials, man power and equipment in budget preparations for highway projects

Module -1	
Various types of highway development projects in progress in India and their scope. Factors to be considered in planning of new highway /expressway / bypass and up-gradation of existing roads. **Planning of Road Projects** –project management framework, scope, project objectives, project environment, causes of project failure, project development process	**10 Hours**
Module -2	
Resource planning – human resources, project man power grouping, structuring site organisation, construction materials- classification of construction materials, materials usage, materials inventory, cost and budget	**10 Hours**
Module -3	
Road construction equipment and choice – different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice Problem on equipment usage charges. Type, capacity and number, task considerations, cost considerations, engineering considerations, equipment acquisition options, optimum location of crushing and mixing plants, problems.	**10 Hours**
Module -4	
Time planning – project work breakdown, determining activities involved, assessment of duration, CPM / PERT network analysis, work scheduling, methods of work scheduling, factors affecting work scheduling, Problems.	**10 Hours**
Module -5	
Planning Control System – resource production, project cost, project time, codification and project management, information system, use of software	**10 Hours**

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Text Books:

K.K. Chitkara. "Construction Project Management Planning, Scheduling and Controlling"- Tata McGraw Hill publications

S.C. Sharma "Construction Equipment and its Management"- Khanna Publishers

Reference Books:

Peurifoy / Schexnayder "Construction Planning, Equipment and Methods"-Tata Mc Graw Hill Publications

IRC "A Manual for the Application of Critical Path Method to Highway Projects in India"

Nhai.org, pmgsy.nic.in websites

Course Name	**TRANSPORTATION ENGG. COMPUTATION LABORATORY**	**Course Code**	**20CVTEPLTC**	**SEE Duration**	**03 Hrs**
Credits	**2**			**CIE+SEE**	**50+50**

COURSE OUTCOMES:

After the completion of the course the student should be able to

Analyze, infer and evaluate traffic and transportation data using computational tools like Excel, R or MATLAB

Simulate or model transportation/traffic data using commercially available software packages like VISSIM and TRANSCAD.

Data handling, analysis and presentation: Using pivot tables, plots, functions and utilities in any standard data analysis tools (Excel, SPSS), regression model etc.

Analysis and programming using simple computational tools: Using MATLAB/R Studio, write simple pseudo codes for analyzing data – reading and writing data, writing expressions - probability expression and computations, regression models etc.

Transport planning exercise: Trip generation model, Trip Distribution – gravity model, Mode choice – logit model, trip assignment – sample network assignment using AON, User equilibrium, and Incremental and Capacity restraint assignment using MS Excel.

Introduction to a traffic simulation tool: Using student version of VISSIM, represent mid-blocks, intersections, networks, design signals and perform signal coordination.

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SYLLABUS
III & IV SEMESTER

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III SEMESTER

Course Type	Course Code	Course Title	Credits				MARKS		
			L	T	P	Total	CIE	SEE	Total
Programme Core-6	20CVTENTIT	Internship (12 Weeks)	-	-	10	10	50	50	100
Programme Core-7	20CVTEPJP1	Project –Phase I	-	-	12	12	50	50	100
Audit-2 (Non-Credit Mandatory Course)	20CVTENCM1	Audit Course – 1	2 units				-	-	-
	Total					22	100	100	200

Course Name	INTERNSHIP	Course Code	20CVTENTIT	Duration	CIE+SEE
Credits	10			8-12 WEEKS	50+50

COURSE OUTCOMES:
After the completion of the course the student should be able to

- Know Transportation Engineering Agency's Administrative structure.
- Exhibit professional abilities pertinent to Transportation Engineering.
- Apply and correlate theory and practice and to communicate effectively regarding complex Engineering activities.
- Engage in life-long learning by observing and examining critically and make corrections cautiously**.**

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IV SEMESTER

Course Type	Course Code	Course Title	Credits				MARKS		
			L	T	P	Total	CIE	SEE	Total
Programme Core-8	20CVTEPJP2	Major Project (Dissertation)	-	-	20	20	50	50	100
Programme Core-9	20CVTEPLTM	TRAFFIC MEASUREMENT LABORATORY	1	1	-	2	50	50	100
Audit-1 (Non-Credit Mandatory Course)	20CVTENCM2	Audit Course – 2	2 units				-	-	-
	Total					22	100	100	200

Course Name	PROJECT PHASE - I	Course Code	20CVTEPJP1	CIE+SEE
Credits	12			50+50

Course Name	MAJOR PROJECT	Course Code	20CVTEPJP2	CIE+SEE
Credits	20			50+50

COURSE OUTCOMES:

After the completion of the course the student should be able to

Show skills in developing research procedures and planning of experiments
Study and infer the analytical and experimental data effectively.
Communicate effectively, apprehend and write reports efficiently.

Course Name	TRAFFIC MEASUREMENT LABORATORY	Course Code	20CVTEPLTM	SEE Duration	03 Hrs
Credits	2			CIE+SEE	50+50

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COURSE OUTCOMES:

After the completion of the course the student should be able to

Measure fundamental parameters of traffic flow and other performance measures of various traffic facilities in the field

Apply tools of data analytics and probability to infer the empirically collected traffic data

Volume and Speed studies:

Direction, Duration and Classification of Traffic Volume at Mid-Block Section and Intersections, Headway Distributions, Registration plate method based surveys - Spot Speed Studies, Time-Space Diagrams – plotting vehicular trajectories and determining traffic flow parameters.

Journey time and delay studies:

Travel Time and Delay Studies by Floating Car Method - GPS

Gap acceptance studies:

Study of Gaps, Lags, Critical Gaps at Intersections

Intersection delay studies:

Delay Measurement at Uncontrolled Intersections and Signalised Intersections

Parking surveys:

Parking Inventory and analysis