

TRAFFIC ENGINEERING- I

Subject Code	: 12 CTM-11	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction: Components of road traffic - the vehicle, driver and road. Objectives and scope of traffic engineering.

Traffic Engineering: Road user characteristics; human and vehicle characteristics, factors affecting road traffic; methods of measurement. Concepts of passenger car units for mixed traffic flow.

Traffic Engineering Studies and Analysis: Sampling in traffic studies; adequacy of sample size; application of sampling methods for traffic studies, objectives, methods of traffic study, equipment, data collection, analysis and interpretation (including case studies) of (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - destination (v) Parking . Traffic manoeuvres and Stream Characteristics; application in intersection design.

Traffic Regulations and Control: General regulations; Regulations on Vehicles, drivers and flow; Other regulations and control. Traffic management; noise and air pollution due to road traffic and method of control.

Traffic Control Devices: Traffic signs, markings, islands and signals. Different methods of signal design; redesign of existing signal including case studies. Signal system and co-ordination. Evaluation and design of road lighting.

ITS: Introduction to Intelligent Transport System- Application of ITS to Traffic Management System- Public Transportation Management System – ITS Case studies.

Note: Field and lab. studies are to be carried out.

REFERENCE BOOKS:

1. Kadiyali, L.R. `Traffic Engineering and Transport Planning', Khanna Publishers.
2. Drew, D.R. `Traffic Flow Theory and Control', McGraw Hill Book Co.
3. IRC and IS Publications.

4. Institute of Transportation Engineers, 'Manual of Transportation Engineering Studies', Prentice Hall
5. Khanna and Justo, 'Text book of Highway Engineering', Nemchand Brothers, Roorkee,2000.
6. Papacostas, C.A.,, Fundamentals of Transportation Engineering', Prentice-Hall of India Private Limited, New Delhi.2000.
7. William R. McShane and Roger P. Roess,, Traffic Engineering', Prentice hall, New Jersey,2000.
8. www.itsa.com
9. www.msrdc.org
10. www.itsindia.org
11. ITS Online @ www.itsonline.com

TRANSPORT PLANNING

Subject Code	: 12 CTM-12	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

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

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

Transport Surveys:Basic Movements- Study Area-Zones-Surveys- Planning of different types of surveys and interpretation, Travel demand; Traffic surveys for mass transit system planning.-

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

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

Land Use Models – Lowry Model-Hansen’s Accessibility Model-Density-Saturation Gradient Model-Problems (Excepton Lowry Model)

REFERENCES:

1. **Kadiyali, L.R.**, 'Traffic Engineering and Transportation Planning' - Khanna Publication, New Delhi, 2009
2. **JotinKhisty and B. Kent Lall** "Transportation Engineering –An Introduction- PHI, New Delhi, 3rd Indian Edition, 2006.
3. **Hutchinson, B.G.**, 'Principles of Urban Transport System Planning' - McGraw Hill Book Co., London, UK, 1982.
4. **Institute of Traffic Engineers** - An Introduction to Highway Transportation Engineering'New York., 1982

APPLIED STATISTICS

Subject Code	: 12 CTM-13	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction: Statistical methods, scope and limitations, population and sample, frequency distribution-measure of central tendency-measures of Dispersion- standard deviation, coefficient of variation, skewness. Variables - scatter diagram, Curve fitting methods, correlation linear regression, multiple linear regressions. Multivariate data analysis.

Probability: Review, Addition & Multiplication Rules, random Variables, Discrete distributions – Binomial & Poisson Distributions, Continuous Distribution – Uniform, Exponential, Gamma & normal Distributions, applications in Highway engineering problems.

Statistical decisions, hypothesis testing, significance levels – Tests concerning Mean, testing the equality of means of two populations, tests concerning the variance. Chi –square Test for goodness of fit. Confidence Interval.

Time series analysis- introduction –moving average- Problems

Optimization technique and applications: Graphical Method –Simplex Method-Big-M method-2 –Phase Simplex method- applications in Highway engineering problems

Use of mathematical and statistical software packages

REFERENCE BOOKS:

1. Gupta, S.C.and Kapoor V.K. Fundamentals of Mathematical statistics, Sultan Chand and Sons, 1978.
2. Medhi J (1982) Introduction to statistics. New age publications, New Delhi
3. Walpole R. E. and R. H. Mayers (1982): Probability and statistics for Engineers and Scientists.Wiley Intl. 2002
4. Johnson R and G. Bhattacharya (1985): Statistics – principles and methods. John Wiley, N Y,
5. Ross S. M. Probability and statistics for Engineers. Wiley Int. Edition
6. Kadiyali L.R. Traffic Engineering and Transport Planning, Khanna Publishers, 2004

PAVEMENT MATERIALS & CONSTRUCTION

Subject Code	: 12CTM 14	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Pavement Materials

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 Tar: Origin, preparation, properties and chemical constitution of bituminous road binders; requirements

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

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

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 - voids in mineral aggregates, voids in total mix, density, flow, stability, percentage voids filled with bitumen

Pavement Construction

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

Subgrade: Earthwork grading and construction of embankments and cuts for roads. Preparation of subgrade, quality control tests

Flexible Pavements: Specifications of materials, construction method and field control checks for various types of flexible pavement layers

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

REFERENCE BOOKS:

1. RRL, DSIR, '**Bituminous Materials in Road Construction**', HMSO Publication
2. RRL, DSIR, '**Soil Mechanics for Road Engineers**', HMSO Publication
3. Khanna, S.K., and Justo, C.E.G., '**Highway Engineering**', Nem Chand and Bros. Roorkee
4. Sharma, S.C., '**Construction Equipment and its Management**', Khanna Publishers

APPLIED SOIL MECHANICS

Subject Code	: 12CTM 151	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction: Soil Mechanics applications to Highway Engg. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems on these.

Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure & Engg behavior of compacted cohesive soil, Field compaction specifications

Filed compaction control, Different types of Equipments used for compaction, their choice.

Shear strength of soil: Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus.

Stability of slopes: Introduction, Types, Different methods of analysis of slopes for $\phi > 0$ & $C-\phi$ soil, Location of most critical circle, Earth dam slopes stability, Taylor's stability number. Effect of Earthquake Force, problems on above.

Permeability of soil: Darcy's Law, Validity, Soil-water system, Types, Determination of permeability, problems.

Site Investigation: Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

Highway Drainage: Introduction, Importance, Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system, Road construction in water logged areas, Land slides – definition, classifies, factors producing.

Reinforced Earth structures Introduction, Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses.

Reference books

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age International Publishers.
2. "Soil Mechanics & Foundation Engg", Dr.B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 16th edition.
3. "Highway Engg", S.K. Khanna, C.E.G. Justo, 5th edition.
4. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard Publishers Distributors.
5. "Soil Mechanics for road Engineers" – HMSO, London.
6. IRC – Relevant Codes.

TRANSPORTATION STRUCTURES

Subject Code	: 12 CTM-152	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

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

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

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

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

Design of Prestressed 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.

REFERENCE BOOKS:

1. Conrad P. Heins and Richard A. Lawrie, `Design of Modern Concrete Highway Bridges, John Wiley and Sons,1999.
2. Baider Bakht and Leslie, G. Jaeger, `Bridge Analysis Simplified, McGraw Hill Book Co,1998.
3. Johnson Victor, `Bridge Engineering', Oxford IBH, New Delhi,2000.
4. Raina, R.K, 'Principles of Design of RCC Bridges, Tata McGraw Hill,1999.
5. Krishnaraju `Bridge Engineering', UPD Publishers, New Delhi,2000.

RAIL ROAD ENGINEERING

Subject Code	: 12 CTM-153	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03

Introduction: Important development of Indian Railways, organization of Indian Railway, Track, Loco, Traction revolution for traffic growth on Indian Railways.

Track & Track Stresses: Permanent way, Track standards & structure, Track Modulus, Forces on the Track, loads, Hammer blow effect Bending Stresses in rail, stresses in Sleeper, Ballast, coning & Tilting of rails, Type of rails, Defect in rails, Rail failure, welding, methods, ultrasonic testing of thermit welding joints, Fastening of rails, fish plates, spikes, bearing plates, pandrol clips, new type of elastic fastening with S.T.sleeper, Rubber pads.

Formation, Sleeper & Ballast: Functions of formation, profile of Banks & cuttings, Track drainage, failure of bank & remedial measures, soil stabilization & Geotextiles methods, sleeper types, sleeper density, functions & requirement and Ballast types.

Point & Crossing & Turnouts: Turnout, type of switches, tongue rail, details of crossing, reconditioning of points & crossings calculation of elements of turnout coles method and IRS method. Symmetrical split, Diamond crossing, modern trend in design, problems.

Geometric Design of Track: Radius, degree of curve, super elevation, gradients, speed calculation, safe speed, equilibrium speed, permissible speed, cant, cant deficiency, negative cant, Transition curve & its design, Types, shift, laying of T.C., vertical curve & its design, problems.

Tractive power & Train resistance: various power requirements for steam, electric loco, diesel loco, Hauling power, resistances developed for Train & problems.

Signal & interlocking: Types of Signal, details of electrical signaling system, track circuits, Absolute block system, Automatic block system, interlocking & methods, Modern signaling techniques, Route relay interlocking, CTC systems.

Metropolitan Railways: Travel pattern, problems, Different forms of urban Transport, Trolley buses, surface railways, underground railways, elevated railways, mono rail, tube railways.

REFERENCE BOOKS:

1. Saxena & Arora. 'Railway Engineering' Dhanpat Rai. Delhi.2000.

2. Ronald.A.Inglis, 'An Introduction to Railway Engineering' Chapman & Hall Ltd. London.1995.
3. W.W.Hay. Railway Engineering Chapman & Hall Ltd.London.1995.
4. Mundrey. J.S. Track Modernization.2000.
5. Manual on Signaling & Interlocking by Indian Railway board.1998.

SEMINAR / ADVANCED PAVEMENT MATERIALS LAB

Subject Code	: 12CTM16	IA Marks	: 50
No. of Lecture Hrs/ Week	:	Exam Hrs	:
Total no. of Lecture Hrs.	:	Exam Marks	:

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

Bitumen : Penetration Test-Ductility Test- Softening point Test-Flash and Fire Point Test- Viscosity test- Stripping Test- Marshall Stability Mix Design-Analysis

Cement Concrete : Normal Consistency Test- Sp. Gravity Test on Cement- Fineness test Cement- Compressive strength of Cement- Tests on Fresh Concrete- Tests on Fine Aggregates.
Cement Concrete Mix Design

Soil : Basic Tests-Gradation-dry and wet-Hydrometer Analysis- Attenberg Limits- Compaction Test- Sp.Gr Test-Density-Sand Replacement Method- Core Cutter method -Triaxial and Shear Test- CBR Test

References:

- i.Highway Material Testing – S K Khanna- C.E.G. Justo, Nemchand Bros-Rooke, 2000
- ii.Relevant IS and IRC Publications.

II SEMESTER
TRAFFIC ENGINEERING –II

Subject Code	: 12 CSE-21	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Traffic Forecast: General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships, methods for future projection.

Design Hourly Volume for Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions. Determination of design hourly volume; critical hour concept.

Highway Capacity: Factors affecting capacity, level of service; Capacity studies Capacity of different highway facilities including unsignalised and signalised intersections. Problems in Mixed Traffic flow; Case studies.

Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions.

Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock Waves; Queuing theory and applications.

Probabilistic Aspects of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications.

Simulation: Fundamental principle, application of simulation techniques in traffic engineering formulation of simulation models, Case studies. Formulation of system models.

REFERENCE BOOKS:

1. Kadiyali, L.R., '**Traffic Engineering and Transport Planning**', Khanna Publications.
2. Drew, D.R., '**Traffic Flow Theory and Control**', McGraw Hill Book Co.
3. Pignataro, Louis; '**Traffic Engineering** - Theory and Practice', John Wiley.
4. IRC Third **Highway Safety Workshop**, Lecture Notes 1978 and other IRC publications.
5. Papacostas, C.A., '**Fundamentals of Transportation Engineering**', Prentice-Hall of India Private Limited, New Delhi.2000.
6. William R. **McShane and Roger P. Roess**, '**Traffic Engineering**', Prentice hall, New Jersey,2000.

ANALYSIS, DESIGN AND EVALUATION OF PAVEMENTS

Subject Code	: 12 CTM-22	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

ANALYSIS AND DESIGN OF PAVEMENTS

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

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

Flexible Pavement Design Methods for Highways: CBR method-Principle -Testing as per IRC, AASHTO and Asphalt Institute and Shell Method. Problems on above

Stresses in Rigid Pavements: Factors affecting design and performance of pavements. 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

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

PAVEMENT EVALUATION

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.

Evaluation of Pavement Structural Condition: Evaluation by non-destructive tests such as FWD, Benkelman Beam rebound deflection using BBD for flexible overlay design, Plate load test, wave propagation and other methods of load tests; evaluation by destructive test methods, and specimen testing.

NOTE: 3 questions should be answered from Part-A and 2 questions from Part-B.

REFERENCE BOOKS:

1. Yoder, E.J., and Witczak, '**Principles of Pavement Design**', 2nd ed. John Wiley and Sons, 1975.
2. Yang, '**Design of Functional Pavements**', McGraw Hill Book Co.
3. Khanna and Justo, '**Test Book of Highway Engineering**' Nemchand brothers, Roorke-2004.
4. Huang, '**Pavement Analysis**', Elsevier Publications
5. Haas and Hudson '**Pavement Management System**', McGraw Hill Book Co., New York.
6. HRB/TRB/IRC/International Conference on Structural Design of Asphalt Pavements.
7. Relevant IRC Publications
8. CMA Hand Book

PAVEMENT MANAGEMENT SYSTEM

Subject Code	: 12 CTM-23	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

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

Pavement Performance: Serviceability Concept- Development of Serviceability Index-PSI-RCI- Roughness- Roughness Components- Evaluation-Equipment- Universal Roughness standard-Techniques-IRI –

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

Evaluation of Pavement Distress and Functional Aspects – Principles- Condition survey-Survey Methodology-Types of Distress-Examples- Equipment-Indexes-Applications of Distress data- Pavement Safety- Components –Evaluation-Basic Concepts of Skid resistance-Methods of measuring skid resistance- Effect of Time ,Traffic and Climate on Skid resistance

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- HDM and other deterioration models

Design Alternatives and Selection: design objectives and constraints, basic structural response models, physical design inputs, alternate pavement design strategies and economic evaluation, life cycle costing, analysis of alternate pavement strategies based on distress and performance, case studies. Equipments

Rehabilitation and Maintenance:Identification of Alternatives- Deterioration Modeling- Priority Programming Methods.

Expert Systems and Pavement Management: Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge-based expert systems, case studies.

Implementation of Pavement Management Systems.- Introduction-major steps-Maintenance Management-

REFERENCES:

1. Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co. 1978
2. Ralph Haas, Ronald Hudson Zanieswki . 'Modern Pavement Management, Kreiger Publications, New York, 1992.
3. Proceedings of North American Conference on Managing Pavement, USA, 2004
4. Proceedings of International Conference on Structural Design of Asphalt Pavements NCHRP, TRR and TRB Special Reports, USA, 2006

ROAD SAFETY AND TRAFFIC MANAGEMENT

Subject Code	: 12CTM-24	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

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.

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.

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.

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.

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.

REFERENCE BOOKS:

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

TRANSPORTATION ECONOMICS

Subject Code	: 12CTM 251	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction: Concepts and Principles of Engineering Economics, Identification and Measurements of Highway Benefits, Highway Transportation Costs, Road User Costs and Benefits, Road User Cost Study in India.

Methods of Economic Analysis: Methods- BCR-NPV-IRR –Their Basic Characteristics, Illustrative applications on above Methods of Economic Analysis, Comparison of the Methods of Analysis when Applied to a Group of Mutually Exclusive Alternatives, Economic Evaluation of Null Alternative, Characteristics and Limitations of the Different Methods of Economic Analysis, Ranking of Independent Projects, Sensitivity Analysis. case studies and problems

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

Supply and Demand: Concept-Definition-Factors affecting Demand and Supply- Shift in Demand and Supply- Transportation demand Model-Equilibrium-Sensitivity of Travel Demand- Elasticities-Consumer Surplus-Marginal Cost- Average Cost- Pricing

REFERENCE BOOKS:

1. Robley Winfrey, '**Economic Analysis for Highways**', International Textbook Company, Pennsylvania. 1990.
2. Jotin Khisty and Kent Lall '**Introduction to Transportation Engineering**' PHI, New Delhi, 2001.
3. Kadiyali.L.R.' '**Traffic Engineering and Transport planning**', Khanna publications, New Delhi, 2000.
4. Relevant IRC Codes and Practices

ROAD CONSTRUCTION PLANNING AND MANAGEMENT

Subject Code	: 12 CTM-252	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Road Planning and Development:- Various Types of Highway Development Projects in Progress in India and their Scope. Planning of New Highway Projects. Consideration of Alternative Horizontal and Vertical Alignments.

Planning and Preparation of Detailed Project Reports:- New Highways Project, Road Improvement and Up-Gradation Projects. Safety Aspects During Road Construction Projects.

Planning Various Construction Activities and their Sequence: Choice of Pavement type, Materials and Specifications of pavement layers. Requirement and Availability of Alternate Construction Materials.

Planning, Use and Management of Equipment in Road Construction:- Use of different Machinery for Road Project, their type, capacity and number. Type of Crushing and Mixing Plants, Optimum location of crushers, mixing plants.

Job Planning through Network Planning - Application of CPM & PERT.

Preparation of BOQ, Cost Estimates, Tender Documents:- Road contracts, different types, procurement guidelines, Contract Documentation, Legal Issues in Contract Management. Value Engineering, Contract Maintenance. Introduction to BOOT and BOT Projects. Use of project management software packages like Primavera, MS Project etc

REFERENCE BOOKS:

1. Peurifoy R. L.- '**Construction, Planning, Equipment and Method**'. TataMcGraw Hill Book Co., Newyork, 2003
2. B. C. Punmia and Khandlwala-“**CPM & PERT**”, Laxmi Publications, New Delhi, 2004
3. Peurifoy R.L. and Schexnayder, “**Construction, Planning, Equipment**

and Methods” – Sixth Edition, Tata McGraw-Hill Publishing Company Limited. New Delhi, 2007.

4. Sharma S. C., “**Construction Equipment and its Management**” Fifth Edition, Khanna Publishers, New Delhi, 2011.
5. **Relevant IRC Codes and MoRTH Specifications**

URBAN PUBLIC TRANSPORT

Subject Code	: 12 CTM-253	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

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.

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

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

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

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.

REFERENCE BOOKS:

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
4. John W. Dickey, '**Metropolitan Transportation Planning**', Tata McGraw-Hill Publishing Co.. New Delhi

III SEMESTER

RURAL ROADS

Subject Code	: 12 CTM-31	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Planning of Rural Roads: Problems associated with planning of low volume rural roads in India .Rural road network planning-principles and methods.

Location Surveys and Geometrics Design: Location surveys,geometric design standards for rural roads, special considerations for rural roads in hilly areas.

Pavement Materials: Soil Investigations,Properties and Specifications of materials, utilization of locally available and waste,materials in village road projects like fly ash, iron and steel slag,recycled and other waste material etc., stabilized roads, road aggregates, materials for bituminous construction, cement and concrete, special pavements .

Pavement Design: Design factors, pavement thickness design as per IRC,internal drainage measures, design of Semi-rigid pavement, roller compacted cement concrete pavement, special pavements like inter locking-block paving, design of fly ash embankments .

Road Drainage: Types of drainage, surface and sub-surface drains for low volume roads .

Construction and Specifications: Earth, Sub-base, Base course and surface course – materials, specifications, and construction steps and use of different

equipment, construction of special pavements, construction of fly ash embankments, lime fly ash stabilized soil, lime fly ash bound macadam, lime fly ash concrete, roller compacted concrete, dry lean fly ash concrete, cement stabilized fly ash, quality control in construction, Specifications and tests for quality control as per IRC .

Maintenance of Rural roads: Types of maintenance, maintenance of unpaved roads, maintenance of paved roads, maintenance of semi-rigid and roller compacted concrete pavements, maintenance of special pavements, Rehabilitation .

Use of rural road planning and evaluation computer packages .

REFERENCE BOOKS:

1. HMSO, “**Soil Mechanics for Road Engineers**”, Her Majesty’s Stationary Office, London.
2. IRC, **Manual for Rural Roads**, Indian Road Congress, 2002.
3. Relevant IRC Publications.
4. PIARC, **International Road Maintenance Hand Book – Maintenance of Paved Roads**, France.
5. PIARC, **International Road Maintenance hand Book – Maintenance of Unpaved Roads**, France.

GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES

Subject Code	: 12 CTM-321	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

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

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.

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.

Note: Computer Lab. using highway geometric design software for design of intersections, interchanges and parking lots to be carried out.

REFERENCE BOOKS:

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

TRANSPORT AND THE ENVIRONMENT

Subject Code	: 12 CTM-322	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Capacity Analysis Concepts: Capacity and level of service, basic capacity under ideal conditions, prevailing conditions and their impact on capacity, standard practices in. highway capacity manual.

Introduction to Freeway Systems: Freeways as part of highway system, operations and design features of freeways, capacity analysis of basic freeway sections, capacity analysis of freeway weaving sections, capacity analysis of ramps and ramp junctions, calibrating relationships for freeway

analysis

Congestion: Management of congested facilities, freeways and surface streets, types of congestion, key issues in freeway congestion, congestion issues related to the surface street system, administrative and planning actions, techniques for addressing freeway system congestion, congestion due to a bottleneck, cumulative demand and capacity, signal remedies in addressing surface street congestion, freeway surveillance and control.

Intelligent Vehicle Highway Systems: Introduction, IVHS programs, role of IVHS in transportation systems of tomorrow, IVHS categories, benefits and costs of IVHS, institutional issues, key considerations.

Safety Design: Safety management systems, hazardous road locations, diagnosis of road accident problems, development of countermeasures, design of roads and intersections as per manual on safety in road design standards, road safety audit, road safety program appraisal, monitoring and program evaluation.

Environment: Air pollution, problem dimensions, emission levels, air-pollution dispersion, The box model, noise generation, noise measurement, noise propagation and mitigation strategies, noise measures, mathematical models of transportation noise, energy consumption and related issues.

Environmental Impact Assessment: Evaluation of environmental impact due to construction of new facilities and the effect of traffic thereon due to Bypasses, widening/four laning, expressway; grade separators or co-ordinated signal system on urban arterial road intersections to reduce air pollution.

REFERENCE BOOKS:

1. Papacostas, C.A., 'Fundamentals of Transportation Engineering', Prentice-Hall of India Private Limited, New Delhi.2000.
2. William R. McShane and Roger P. Roess., 'Traffic Engineering', Prentice hall, New Jersey.2000.
3. Institute of Transportation Engineers, 'Traffic Engineering Hand Book', Prentice Hall, New Jersey,1985.
4. Ogden K.W "Safer Roads - A Guide to Road Safety Engineering', Avebury Technical, Aldershot . UK.1990.

5. MOST, 'Manual For Safety in Road Design', Ministry of Surface Transport. Govt. of India.

TRANSPORTATION SYSTEMS

Subject Code	: 12 CTM-323	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction to Transportation Engineering, Transportation System Engineering, Transportation organizations and functions.

The Transportation system; Components & classification of Transportation systems, Transportation vehicles and containers, Plant and traffic, Transport routes.

Technological characteristics of different systems Principles and functions of important systems elements in Highway, Railways, Water ways, Airways, & Rope ways etc. Technological" characteristics classification, Guidance & Maneuverability, Buoyancy and stability of ship & aircraft, Effects of resistances on transport, Propulsion force, Horsepower and Elevation & grades & problems on above.

Operating Characteristics of Transport Systems comparative studies operating characteristic of different modes & systems of transport & problem on above.

Terminals; functions, analysis and typical characteristics.

Co- ordination operational control & coordination principles, Limitations, Functions of operational control, communications & signals, Navigational aids etc..

System operation & Management & Decision making in Transportation management. Management of a facility was A road traffic model for major activity_ centers, carrier at integrated operations planning, Transportation decisions - making, multiple - objective evaluation & selection methods.

Transportation Systems maintenance.

REFERENCE BOOKS:

1. **“An Introduction to Transportation Engineering”**
Willian & Hay. John Wiley & Co.
2. **“An Introduction to Transportation Engineering & planning by Edward. K. Modok. John Wiley & Co”**
3. **“An Introduction to Transportation Engineering”** by Evere
H.C.Carier. & Wolfgang. S. Homburger Reston Publishing inc.

ELECTIVE – 1

ROAD PROJECTS

Subject Code	12CTM 331	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total No. of Lecture Hrs.	: 52	Exam Marks	: 100

Various steps of preparation and execution of road projects, Investigations for preparation of project reports for new and upgradation of roads. Objects and scope of pre – feasibility, feasibility and detailed studies for project preparation. Typical HR structure for preparations and implementation of road projects

Topographic surveys and investigations for finalisation of horizontal alignment and vertical profile of roads, Application of GIS. Design standards and specification for relevant road geometrics.

Soil investigations for assessing the design details of road embankments and cuts, drainage requirements and foundation of cross drainage structures

Material surveys and investigations for availability and choice of basic and alternate materials for road construction and for soil stabilisation

Traffic studies – classified traffic volume, growth rate, projected traffic for assessing road way requirements, origin-destination characteristics and studies, Axle load / wheel load studies using weigh bridges and analysis of data for pavement design

Environmental and social impact studies and assessment relevant to road upgradation / new projects, Mitigation measures, Road safety audit

Collection of relevant data, analysis and interpretation for pre-feasibility and feasibility study reports of the proposed road project. Economic evaluation of different possible alternatives. Preparation of drawings and project reports. Use of software

Preparation of DPR design details, estimates, BOQ, drawings and detailed project report, use of software

Tendering process - Preparation of tender documents for different types of road projects, tender evaluation

REFERENCE BOOKS:

1. IRC: SP:19 - 2001, Manual for Survey, “**Investigation and Preparation of Road Projects**”- (first revision), Indian Roads Congress
2. IRC: SP: 30 - 1993, “**Manual on Economic Evaluation of Highway**”- Projects in India (first revision), Indian Roads Congress
3. IRC SP – 38,”**Manual for Road Investment Decision Model**”- 1992, Indian Roads Congress
4. IRC : 9-1972, 35 – 1997,38-1988, 39-1986, 52-2001, 54-974, 62-1976, 64-1990, 66-1976, 67-2001, 69-1977, 73-1980, 79-1981, 80-1981, 86-1983, 98-1997, 99-1988, 103-1988, 104-1988, 110-1996 Indian Roads Congress,
5. MoRTH “**Specifications for Road Bridge Works**”- 2001, fourth revision, Indian Roads Congress
6. MoRTH “**Standard and Bidding Document Procurement of Civil Works**”- Part I and II, 2000, Indian Roads Congress
7. MoRTH “**Model Concession Agreement for Small Road Projects**”-2000, Indian Roads Congress

Standard Data Book on Highway Technology issued by the University may be referred in the P.G Examination of VTU.

GEOGRAPHIC INFORMATION SYSTEMS

Subject Code	: 12 CTM-332	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Geographic information concepts and spatial models – Introduction, spatial information, temporal information, conceptual models of spatial information, representation of geographic information.

GIS Functionality – Introduction, data acquisition, preliminary data processing, data storage and retrieval, spatial search and analysis, graphics and interaction.

Computer Fundamentals of GIS and Data storage Fundamentals of computers vector/ raster storage character files and binary files, file organization, linked lists, chains, trees.

Coordinate systems and map projection: Rectangular, polar and spherical coordinates, types of map projections, choosing a map projection.

GIS Data models and structures – Cartographic map model, Geo- relation model, vector/ raster methods, non – spatial data base structure viz.. hierarchal network, relational structures.

Digitizing Editing and Structuring map data – Entering the spatial (Digitizing), the non- spatial, associated attributes, linking spatial and non-spatial data, use of digitizers and scanners of different types.

Data quality and sources of error – Sources of errors in GIS data, obvious sources, natural variations and the processing errors and accuracy.

Principles of Spatial data access and search, regular and object oriented decomposition, introduction to spatial data analysis and overlay analysis, raster analysis, network analysis in GIS.

GIS and remote sensing data integration techniques in spatial decision support system land suitability and multioriteria evaluation, rule based systems, network analysis, special interaction modeling, Virtual GIS.

Data base positioning systems, desirable characteristics of data base management systems, components of a data base management system, understanding the data conceptual modeling.

Global positioning system, hyper spectral remote sensing, DIP techniques, hardware and software requirements for GIS, overview of GIS software.

REFERENCE BOOKS:

1. Peter A Burrough Rachael A Mc Donnel, “**Principles of GIS**”(Oxford),2000.
2. Christopher Jones, “**GIS and Computer cartography**”(Longman),2000.
3. Lillesand, “**remote sensing and image interpretation**“(John Wiley and Sons),2000.

5. James L Riggs, ‘**Engineering Economics**’ 4th Edition, Tata McGrawhill, New Delhi, 2005
6. Prasanna Chandra, ‘**Financial Management**’ 5th Edition, Tata McGrawhill, New Delhi, 2005

INFRASTRUCTURE MANAGEMENT

Subject Code	: 12CTM 333	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Framework for Infrastructure Management: Definition, key issues for infrastructure management, applications of systems methodology, development of infrastructure management system, life-cycle cost analysis concept.

Planning Needs Assessment and Performance Indicators: Infrastructure planning, examples of planning studies, life-cycle management, infrastructure service life, needs assessment and performance.

Information Management and Decision Support Systems: Data base management, data needs and analysis, inventory data, inservice monitoring and evaluation data, uses of monitoring data and examples of in- service evaluation

Concepts of Total Quality Management: Design for infrastructure service life, construction quality control and quality assurance, maintenance, rehabilitation and reconstruction strategies, reliability-centered maintenance, maintenance management, new methods and materials for infrastructure use
Economics, Life-Cycle Analysis and Maintenance Programming: Maintenance, rehabilitation and reconstruction policies, example applications for roads, water mains, sewer mains, buildings, evaluating effectiveness, environmental impact and policies, life-cycle cost-benefits analysis, priority analysis methods.

Infrastructure Management Development and Implementation:
Concepts of integrated infrastructure management systems, visual IMS,
benefits of implementing and IMS, evaluation methodologies.

REFERENCE BOOKS:

1. W. Ronald Hudson, Ralph Haas and Waheed Uddin, '**Infrastructure Management: Design, Construction, Maintenance, Rehabilitation, Renovation**', McGraw Hill Co., 1997
2. Neil S. Grigg, '**Infrastructure Engineering and Management**', John Wiley and Sons
3. W. Ronald Hudson, Ralph Haas and Zeniswki, '**Modern Pavement Management**', McGraw Hill and Co.