CE 5001: MATERIAL SCIENCE & CONCRETE TECHNOLOGY

Theory:

Unit-1:

Structure of Solid materials, Atoms and bonds, Inter-atomic and Intermolecular bonds, Crystals, Classification of solids.

Mechanism of elastic and plastic actions in Tension, Compression, Pure bending and torsion, Elastic and inelastic Properties of solids, dislocations, Strain hardening, Triaxial stress.

Unit-2:

CREEP: Components of creep fracture, analysis of creep curves, method of predicting creep strength, Designing of creep.

FATIGUE: Fatigue loading, mechanism, factors affecting creep fatigue properties, S.N. Diagrams.

HARDNESS: Relation between hardness of different Atomic structure measurement of hardness with other mechanical properties.

Unit-3:

CONCRETE MATERIALS: Cement, Manufacture, Composition, Structure, Hydrated Cement Paste, heat of Hydration, Test for physical properties, different types of Cements, properties of aggregates.

FRESH CONCRETE: Workability, Factors affecting, Testing, vibration analysis of fresh concrete.

STRENGTH OF CONCRETE: Nature of strength, Factors affecting, Autogenous heating, Maturity of concrete, Fatigue strength, Impact strength.

Unit-4:

ELASTICITY SHRINKAGE AND CREEP: Modulus of elasticity, Dynamic Modulus, poisons ratio, early volume changes, swelling, shrinkage, creep factors influencing creep nature. Rheological models, effects and design for creep.

DURABILITY OF CONCRETE: Permeability of concrete, Thermal properties of concrete, resistance of concrete to Fire, Resistance to abrasion, Electrical properties, Acoustic properties, Chemical attack.

Unit-5:

TESTING OF HARDENDED CONCRETE: Destructive and non destructive testing of concrete, Tests on composition of hardened concrete, variation of test results, Accelerated testing of concrete.

MIX DESIGN: Basic consideration, factors in choice of mix. Proportion, Methods of mix design, I.B.C. Murdock, A.C.I. Method based on Road note No. 4, Design of different types of concrete: light weight and high density.

Books & References Recommended:

1. Concrete Technology by Neville
2. Concrete Technology by Shetty

CE-5002 : SYSTEM MATHEMATICS & MATHEMATICAL MODELLING

Theory:

Unit-1 :

Concept of a System & System Analysis, Mathematical Modelling. Introduction to Mathematical Programming Techniques viz – Non Linear Programming, Geometric Programming, Quadratic Programming, Linear Programming, Dynamic Programming, Game Theory ect. Assignment & Transportation problems, their formulations & solutions.

Unit-2:

Linear Programming, formulation, Graphical solution, Simplex method, BIG-M & Two Phase methods, Duality in LP, Revised Simplex.

Unit-3 :

Network Analysis, CPM-PERT technique, Project Optimality Analysis, Updating, Dynamic Programming, Stage Coach Problem & its D.P. solution.

Unit-4 :

Measures of Central Tendency, Central Limit Theorem, Statistical Frequency distributions, Additional and Multiplication laws of Probability, Baye's Theorem, Mathematical Expectation, Binomial, Poisson, Normal 't', 'F' & Square Distributions, Tolerance limits, Confidence limits, Tests of Significance, Analysis of Variance.

Unit-5 :

Linear & Non-linear Regression Analysis, Testing of Hypothesis, Acceptance Sampling, Fundamentals of Simulation, Introduction to Sensitivity Analysis, its limitations.

Books & Reference Recommended:

1. Operation Research by Phillips & Ravindran
2. Operation Research by TAHA
3. Probability, Statistics & Decision in Civil Engineering by Benjamin & Cornell
4. Optimization by S.S. Rao

CE 5403: ALIGNMENT & GEOMETRIC DESIGN OF HIGHWAYS

Theory:

Unit -1:

PRINCIPLE OF ROUTE SELECTION AND HIGHWAY LOCATION: Reconnaissance, Preliminary and final location surveys. Different Studies for Route locations: Traffic, Soil and Materials, Drainage etc. Use of Aerial Photographs and Remote Sensing in route location, preparation and presentation of project documents.

Unit-2:

HIGHWAY FINANCING, ECONOMICS AND ADMINSTRATION: Financing of Highways, revenues and expenditures, Highway financing in India. Economics of Highway improvements, Highway administration and planning in India, Saturation System.

Unit-3:

CLASSIFICATION OF HIGHWAY: Terrain classification, design speed and other factors for Geometric design, uniform and nno-uniform acceleration theory.

CROSS SECTIONAL ELEMENTS: Road lines, building and control lines, roadways, width, shoulders, median, Camber.

SIGHT DISTANCES: Analysis of stopping sight distance, Intermediate and passing sight distance.

Unit-4:

HORIZONTAL ALIGNMENT: Design Radius, dynamics and motion of vehicle on a curve, Friction between tyre and road surface, Different curves, Superlevation, widening and transition curves, setting of transition spiral, use of tables.

Unit-5:

VERTICAL ALIGNMENT: Gradients, Grade Compensation, Relation between gradient and camber, Design of Summit and Valley curves, Design criteria for hair pin bend, Design of curves in tight locations, lateral and vertical clearances, under passes, coordination of horizontal and vertical alignment, set back distances.

Books & References Recommended:

1. IRC Special Publication 19-1977, Manual for Survey Investigation and Preparation of Road Project.
2. IRC Special Publication 20-1979, Manual for Route Location, Design Construction and Maintenance of Rural Highways.
3. IRC-73-1980, Geometric Design Standards for Rural Highways.
4. IRC-52-1970, Design Tables for Horizontal Curves for Highways.
5. IRC-52-1973, Recommendation about the Alignment Survey Geometric Design of Hill Roads.
6. Drew, Traffic Flow Theory.
7. Sharma S.K., Principle Practice and Design of Highway Engg.
8. Kadiyali L.R., Highway Engg.
9. Kadiyali L.R., Principles of Highway Engg.

CE 5404: SOIL MECHANICS IN HIGHWAY ENGINEERING

Theory:

Unit-1:

CLASSIFICATION OF SOILS: IS Classifications, AASHO Classifications, CAA Classifications.

CBR and group index: Laboratory and field determination of CBR value, effect of soaking, modulus of sub-grade reaction.

Unit-2:

COMPACTION: Theory of compaction, factors affecting compaction, effect of compaction on soil, properties, measurement of field compaction and field methods of compaction and control.

Unit-3:

BEARING CAPACITY: Skemptons's analysis, Plate Load Test, penetration tests, General bearing capacity equation, effect of water table on bearing capacity.

Stability of slopes: Types of slope failure, Bishop's slope stability analysis, Stability number.

Unit-4:

EARTH PRESSURES: Classical theories, effect of submergence and seepage.

Unit-5:

SOIL STABILIZATION: Mechanics of stabilization, Mechanical, Electrical, cement, lime, Bitumen and Chemical Stabilization.

DRAINAGE: Vertical sand drains, Surface and sub-surface drainage for highways, Drainage for Hill roads.

Books &Reference Recommended:

3. Singh Alam, Soil Engineering in Theory and Practice, Asia Publishing House.
4. HMSO, Soil Mechanics for Road Engineers.
5. Khanna S.K. and Justo, C.G., Highway Engineering.
6. Punmia B.C., Soil Mechanics and Foundation Engineering.
7. Prora, Soil Mechanics.
8. Venkat Ramaiha, Soil Mechanics.
9. IRC-49-1973, Recommended Practice for the Pulverization of B.C. for lime Stabilisation.
10. IRC-50-1973, Recommended Design for the use of Cement-Modified Soil in Road Constructions.
11. IRC-51-1992, Guideline for the use of Soil Lime Mixing Road Construction.

CE 5405: TRAFFIC ENGINEERING

Theory:

Unit-1.

TRAFFIC CHARACTERISTICS: Road user, Vehicle, Speed Studies, Different Traffic Surveys and Studies.

Non-signalised Intersections: At grade and grade separated intersection, channelization warrants, weaving action at intersections, delay models, Theoretical models for determining weaving capacity, design of intersection.

Signalized Intersections: Warrants for the use of traffic signals, phasing, signal aspects and the intergreen period, determination of effective green time, optimum cycle time and timing diagram, effect of left and right turning and hetrogenity, P.C.U. concepts, ultimate capacity of whole intersection, delay calculation and optimum cycle length, que lengths at the commencement of green period, coordination of traffic signals.

Unit-2

TRAFFIC FLOW MODELS: Elements of traffic flow, fundamental diagram of road traffic, relationships between the variables, macroscopic and microscopic flow models based on response – Stimulus approach, Hydrodynamic analogy, Queuing model.

Unit-3

PARKING: Parking survey, types of parking, parking meters, design of parking places.

LIGHTING: Lantern arrangements, types of signs and marking and their design.

ACCIDENTS: Causes, data collection, analysis of accident data, Collision and condition diagram, remedial measures for accidents.

Unit-4

HIGHWAY CAPACITY: Basic, Possible and Practical capacities, level of service concept, factors affecting capacity and level and service, capacity of freeway, experessway, Urban Streets.

Unit-5

TRAFFIC MANAGEMENT: One way street, twoway, flow operation, closing side streets, exclusive bus lanes.

Instruments for volume measurement, spot speed measurement, electronic timers cameras, Radar Photography, Vehicle Mounted Instruments, measurement of concentration.

Books & References Recommended:

1. Louis J. Pignataro, Theory and Practice, Prentice-Hall.
2. Kadiyali L.R., Traffic Engg. And Transport Planning.
3. IRC-65-1976, Recommended Practice for Traffic Rotaries.
4. IRC-SP-12-1973, Tentative Recommendation on the Provision of Parking space for urban area.

CE 5452: DESIGN & CONSTRUCTION OF RIGID PAVEMNTS

Theory:

Unit-1:

THEORIES OF DESIGN OF RIGID PAVEMENTS: Wastergaurds analysis, pickets solution, Westergaurd formula for loads on applied area, Finite difference method, linear elastic layer method, Finite element method, Deflection in rigid pavements.

Design of concrete pavements: ESWL, Stress calculations, curling stresses, frictional stresses, infiltration stresses and load stresses, slab thickness design, use of charts and formula for diff. Load positions, Design of airfield pavements.

Unit-2:

PAVEMENT JOINTS: Types of joints, contraction and warping joints, dowel bars and tie bars, Temperature reinforcements, filling and sealing of joints.

Unit-3:

CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS: Width and thickness of slab, Reinforcing steel design, Design and construction criteria, Factors affecting, crack width and spacing of CRC pavements, design of CRC pavement for Highway and Airfield.

Unit-4:

DESIGN OF PRESTRESSED CONCRETE PAVEMENTS: Stresses in pavements, Thickness design and pre-stressing techniques.

EVALUATION AND STRENGTHENING: Performance evaluation, safety, serviceability and durability concepts, Design of overlays on rigid pavements, fibrous concrete overlays, economics of rigid pavements, construction and maintenance.

Unit-5:

CONSTRUCTION OF RIGID PAVEMENTS: Formwork, mixing, spreading, compaction and finishing, slip form pavers.

CEMENT CONCRETE MIXES: Methods with special reference considering the requirements of pavements, comparison of different methods.

Books & Reference Recommended:

1. H.M.S.O. Concrete Road, Design and Construction.
2. Yodar E.J., Principle of Pavement Design
3. IRC-18-1981, Standards, Specifications and Code of Practice for Construction of Concrete Roads.
4. IRC-58-1988, Guidelines for the design of Rigid Pavements for Highways.
5. IRC SP-49-1988, Guidelines for the use of Dry Lean Concrete as Sub Base for Rigid Pavements.
6. IRC-15, Standard Specification and Code of Practice for Construction of Concrete Roads..
7. IRC-44-1976, Tentative Guidelines for CC Mix Design for Pavements.
8. IRC-SP-46, 1977, SFRC for Pavement.
9. Sharma S.K., Principle Practice & Design in Highway Engineering.

CE 5453: DESIGN AND CONSTRUCTION OF FLEXIBLE PAVEMENT

Theory:

Unit-1:

Equivalent single wheels load concepts and applications, Relationship between wheel arrangements and loading effects, tyre contact area, Effect of load repetition, Effect of transient loads, Impact of moving loading, Factors to be considered in Design of pavements, Design wheel load, soil, climatic factors, Pavement component materials, Environmental factors, Special factors such as frost, Freezing and thawing.

Unit-2:

Design of Flexible Pavements: Methods of design, empirical, semi empirical and analytical, Group Index, CBR, California Resistance value, Triaxial, Mcleod, Burmister and F.A.A. method, Pavements models and stress analysis of pavement system, Design of flexible pavement for airfields.

Unit-3:

Construction of flexible pavements: Type of Highway construction, Earth road and Gravel roads, soil stabilized roads, W.B.M. roads, black top roads, seal coat, prime coat and tack coat, premix, Bituminous construction procedures: Surface dressing, Grouted macadam, Bitumen bound macadam, Bituminous carpet, Benkelman Beam method, Pavement roughness and pavement strength, fracture patterns and disintegration, present serviceability of pavement system and cost analysis, optional selection of flexible pavement component.

Unit-4:

Design of bituminous concrete mix: Principles of mix Design, Factors, Method: Marshall, Habber and Field, Hveem, Triaxial, Comparison of different methods.

Unit-5:

Strengthening of pavement: Types of failure, remedial measurement, Pavement Evaluation Methods.

Books & Reference Recommended:

1. Yoder E.J., Principle of Pavement Design
2. IRC-37-1980, Guidelines for the Design of Flexible Pavements.
3. IRC-16-1981, Specification For Road and Bridge Work, (MORT & H).
4. Khanna & Justo, Highway Engineering.
5. Kadiyali L.R., Principle and Practice of Highway Engineering.
6. Sharma S.K., Principles, Practice & Design in Highway Engineering.
7. IRC-81-1997, Tentative Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique.

CE 5454 :SYSTEM ANALYSIS & URBAN TRANSPORTATION

Theory:

Unit-1:

Probability, statistics for traffic Engineering design: Random variable and statistical measures, Basic concept of probability, probability – laws, Binomial, Poisson, Normal and Exponential distributions.

Sampling theory and regression analysis, General consideration of the accuracy, cost and time requirements of data collection, sampling theory and principles for determining sample size and accuracy relationship, principles of the population mean and standard deviation, regression analysis examples.

Unit-2:

Traffic forecasting: Principles and techniques, Demand, price and capacity relationships, price elasticity, forecasting for long term demand, variables, determination of the design hourly volume.

Planning methods of transport system planning, stages of planning, Transportation study area, collection of travel data, external cordon and screen-line, survey, zoning types of surveys.

Unit-3:

Trip Generation Models: Introduction and definition, Factors governing trip generation, multiple linear regression analysis, aggregated and disaggregated analysis, Category analysis.

Unit-4:

Distribution Models: Methods of trip distribution, Growth factor models, Gravity model, Tanner model, intervening opportunity model, competing opportunity model.

Assignment models: General principle, Assignment techniques, All or nothing Assignment, multiple route assignment, capacity restraint assignment, diversion curves.

Unit-5:

Economic analysis: Need, costs and Benefits, Time horizon in Economic assignment, basic principles, methods of Economic evaluation.

Traffic and the Environment, effects of traffic on the environment.

Books & Reference Recommended:

1. Kadiyali L.R., Traffic Engineering and Transport Planning.
2. Martine Wool and Brain V.Martin, Traffic System Analysis.
3. Hutchinson B.G., Principles of UTS Planning, Mc Graw-Hill Publish.
4. Saxena, Traffic Planning and Design.
5. Bruton M.J., Introduction to Transportation Planning.

CE 5455: TRANSPORATION PLANNING

Theory:

Unit-1.

Transportation in Society: Role of transportation (Land, air, water) in civilization, Economic, social, political, environmental roles of transportation today in India.

Unit-2.

The fields of Transportation Engineering: Different fields involved, system planning, scientific approach to model development science and professional judgment, organizations.

Component of transportation system: Transport technology, transportation systems, Transportation network and their analysis, vehicle and containers.

Unit-3.

Vehicle Motion: Equations of motion, Resistances, Path characteristics, Prediction of vehicle performance, Generalized vehicle performance relationships, work, energy and fuel consumption, Continuous flow system: General characteristics, belt conveyors, pipe lines, capsule pipe lines, concepts of flow and design.

Terminals: Functions, Analysis, Process flow charts, Terminal processing time, waiting times, capacity and level of service concepts simulation probability density functions. Queuing theory, Passenger and Fright terminals, air, bus, railroad.

Unit-4:

Transport costs, Demand and Supply: Concepts, types, future costs and present value, Treatment of inflation, cost estimating methods, choice of technology and cost output relationships, Demand function, demand models, urban travel forecasting model, Demand for freight transportation, Projection techniques, Theory of transport supply, supply characteristics of transport facilities, pricing, supply characteristics o carriers, supply relationships for an urban transit time.

Transportation Network Flows: Merging of demand and supply relationships, Economic market equilibrium and extension to include level of service, network equilibrium traffic assignment.

Unit-5:

Environment impacts: Noise impact, air pollution, impact on land and value, vibration, evaluation procedures, situation in India.

Decision making: Characteristics of transportation problems, problem solving process, multiple objective evaluation and selection methods, selection procedures, Economic evaluation methods, Long range transportation planning, Types of planning process Data base, Alternatives and their generation.

Operation plans, system operation and management: Operation plans, components, single line analysis, Network relationships, TSM Management scheme for reducing congestion in CED and on streets, Reducing travel peaks, traffic Engg. Measures, Road Traffic models for CBD, corridor operation planning, maintenance, Integrated operation planning and design of a system, Implementation: Urban transportation legislation, legal powers, financing.

Books & Reference Recommended:

1. Edward K. Morlok, Introduction to Transportation Engineering an Planning, Mc Graw Hill Book Co.
2. John W. Dickey, Metropolitan, Transportation Planning, Mc Graw Hill Co.
3. Kadiyali L.R., Traffic Engineering and Transportation Planning, Khanna Publication, Delhi.
4. Wohl, Martin and Brien V.Martin, Traffic System Analysis for Engineeers and Planners, Mc Graw Hill Book Co.
5. Hutkinson, Bruce D., Principles of Urban Transport System Planning, Mc Graw Hill.

CE 5472: ANALYSIS AND PLANNING OF MASS TRANSPORTATION SYSTEM

Theory :

Unit-1:

Urbanisation, Travel Demand Estimation

Unit-2.

Mass Transport Demand Estimation, Mass Transport Network Design

Unit-3

Scheduling of Mass Transport System, System Selection & Evaluation Criteria.

Unit-4

Bus & Truck Guides System

Unit-5:

Transport System Measures, Case Studies.

Books & Reference Recommended:

1. Alan Blark, Urban Mass Transportation Planning, Mc Graw Hill, Series.
2. Giannopoulos G.A., Bus Planning and Operation in Urban Areas A- Practical Guide, Gower Publishing, 1989.