SHRI G. S. INSTITUTE OF TECHNOLOGY AND SCIENCE, INDORE

SYLLABI

FOR MTech (TRANSPORTATION ENGINEERING) COURSES

SESSION 2023–24

CIVIL ENGINEERING & APPLIED MECHANICS DEPARTMENT

VISION AND MISSION OF THE INSTITUTE

Vision

A front-line institute in science and technology making significant contributions to human resource development envisaging dynamic needs of the society.

Mission

To generate experts in science and technology akin to society for its accelerated socioeconomic growth in professional and challenging environment imparting human values.

VISION AND MISSION OF THE DEPARTMENT

Vision

A strong source in Civil Engineering field making significant contribution to human resource development considering dynamic needs of the society.

Mission

M1 - To generate experts in Civil Engineering field, useful for the nation and society.
M2 - To develop students for accelerated socioeconomic growth in professional and challenging environment of industries in modern world.
M3 - To motivate the students to apply the knowledge of civil engineering, preserving human values

M.Tech in Transportation Engineering	
Program Outcomes (POs)	
PO-1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO-2	An ability to write and present a substantial technical report/document.
Po-3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PSO-1	Gain knowledge / skill in transportation engineering for collaborative multidisciplinary solutions and carry out planning and management of projects as a member and a leader in a team considering economic and financial factors.
PSO-2	Recognize the need for, and have ability in lifelong learning independently for professional advancement, demonstrate professional ethics, work culture and understanding of responsibility to contribute to community for sustainable development of society.
Program Educational Objectives (PEOs)	
PEO-1	Graduates of the program will have in-depth knowledge to identify and formulate challenging problems in transportation engineering, apply appropriate research methodologies, use modern engineering tools and provide technically sound, economical and sustainable solutions.
PEO-2	Graduates will have ability for higher studies and undertake high value research on transportation engineering and other related issues.
PEO-3	Graduate of program will have sound analytical and lateral thinking ability to engage in lifelong learning for professional advancement to cope up with multidisciplinary and changing technologies in transportation engineering.
PEO-4	Graduates of the program will have sense of social responsibility, will demonstrate ability to communicate and work effectively as a team member in an ethical way, and will play leadership roles in their profession, public services and community.
PEO-5	Communicate effectively and lead multidisciplinary terms to solve traffic and transportation related problems with professional ethics.

SEMESTER I

CIVIL ENGINEERING AND APPLIED MECHANICS DEPARTMENT
M. E.

CE 54011: TRAFFIC ANALYSIS

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES (CO): At the end of the course, students will be able to

1) Estimate basic characteristics of traffic stream.
2) Conduct traffic studies and analyze traffic data.
3) Model traffic stream behavior.
4) Determine the capacity of highways.
5) Analyze the traffic data and interpret the results.

COURSE OUTCOMES (CO)

1. Explain the Components of the Traffic System – Explain the interaction between human, vehicle, and environment systems, and analyze the characteristics of road users, vehicles, and pedestrians.
2. Analyze Traffic Data Collection Methods – Identify and apply different traffic study techniques, including volume, speed, travel time, intersection, and parking studies, using both conventional and advanced technologies.
3. Evaluate Macroscopic Traffic Stream Models – Interpret traffic flow fundamentals and apply hydrodynamic and kinematic analysis principles to understand traffic fluid state considerations and platoon diffusion.
4. Examine Microscopic Traffic Stream Models – Analyze car-following behavior, gap acceptance models, and the impact of mixed traffic flow behavior, including non-lane-based movement and heterogeneity.
5. Perform Highway Capacity and Level of Service (LOS) Analysis – Assess the factors influencing capacity and LOS for freeways, multi-lane roads, urban arterials, and intersections using US Highway Capacity Manual (HCM) and IRC standards.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	1
CO2	3	3	3	2	2
CO3	3	2	3	3	1
CO4	3	2	3	3	1
CO5	3	3	3	2	2
Target	3	2.4	3	2.4	1.4

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content:

UNIT 1

Components of Traffic System: Introduction, Human-vehicle-environment system, Characteristics of road users, characteristics of vehicles, Characteristics of Pedestrians.
Characteristics of Traffic: Fundamental parameters of traffic and relationships; Time headways, flow patterns; Interrupted and uninterrupted traffic; Microscopic and macroscopic speed characteristics; Speed characteristics- mathematical distributions; Speed and travel time variations.

UNIT 2

Traffic Data Collection studies: Traffic study components, types of data; Volume studies; Speed studies; Travel time and delay studies; Intersection studies, Pedestrian studies; Parking studies, Vehicle detection methods; Advanced methods: GPS, Instrumented Vehicles, Image Processing, Bluetooth, Infrared methods, Sample selection; Region traffic counts; Growth factors.

UNIT 3

Macroscopic Traffic Stream Models: Stream flow fundamentals; family of models, Hydrodynamic and Kinematic Analysis of Traffic: Continuity equation; Waves in traffic, Traffic fluid state considerations, Continuity equation; Waves in traffic, Traffic fluid state considerations; Platoon diffusion.

UNIT 4

Microscopic Traffic Stream Models: Car-following: Stimulus-response; Distance based models; Gap acceptance models; Mixed traffic flow behavior: Non-lane based movement, Heterogeneity, Applications.

UNIT 5

Highway Capacity Analysis: Capacity and level of service concepts; Factors affecting capacity and LOS; Freeway and multi-lane analysis; Capacity of Urban arterials; Signalized intersections; Un-signalized intersections; US Highway Capacity Manual (HCM) and IRC standards, Indo-HCM standards.

Books & References Recommended

1. Adolf D. May, Traffic Flow Fundamentals, Prentice Hall, 1990.
2. C. JotinKhisty , B. Kent Lall, Transportation Engineering: An Introduction, Prentice Hall;

3rd Edition, 2003.

3. ChakrobortyPartha, Das Animesh, Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 1st Edition, 2009.
4. Fred L. Mannering, Scott S. Washburn, Kilareski Walter P., Principles Of Highway Engineering And Traffic Analysis, Wiley India Pvt Ltd., 4th Edition, 2011.
5. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2011.
6. Louis J. Pignataro and Edmund J. Cantilli, Traffic Engineering: Theory and Practice; Prentice Hall, Inc., 1973
7. Mike Slinn, Paul Matthews, Peter Guest, Traffic Engineering Design: Principles and Practice, Butterworth-heinemann, 2nd Edition, 2005.
8. Nicholas J. Garber, Lester A. Hoel, Nicholas J. Garber, Lester A. Hoel, Principles of Traffic and Highway Engineering, Cengage Learning India, 2nd Edition, 2010.
9. Roger P. Roess, Elena S. Prassas and William R. McShane, Traffic Engineering, Prentice Hall, 4th Edition, 2010.
10. TRB Highway Capacity Manual, Transportation Research Board, Washington, D.C., 2010.

CE : CONCRETE TECHNOLOGY AND COMPOSITES

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1) Explain the characterization of constituents of concrete.
2) Design concrete mix by various methods as per different codes.
3) Explain the different types of admixtures, mix design, properties and applications of special concretes.
4) Illustrate the mechanical behavior of layered composites compared to isotropic materials.
5) Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro levels.

COURSE OUTCOMES: The students will be able to

1) Define hydration of cement and tests on properties of cement and aggregates.
2) Compare the properties and testing of concrete in fresh and hardened state.
3) Illustrate the shrinkage and creep mechanisms, curing and durability of concrete.
4) Design concrete mixes by various methods.
5) Explain the types of admixtures, and applications of special concretes.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	1
CO2	3	2	3	3	2
CO3	3	3	3	2	2
CO4	3	2	3	3	1
CO5	3	2	3	3	1
Target	3	2.2	3	2.6	1.4

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content:

Unit - 1.

Cement: Types of cement and their composition - Manufacture of Portland cement - Hydration of cement and hydration product - Structure of hydrated cement - Heat of hydration - Gel theories - Review of tests on properties of cement.

Aggregate: Classification of aggregates - Particle shape and texture - Bond and strength of aggregate and its influence on strength of concrete - Porosity - Absorption and moisture content and their influence - Soundness of aggregate - Alkali aggregate reaction - Sieve analysis and grading of aggregate - Review of tests on properties of aggregate.

Properties of Concrete: Mixing and batching - Workability - Factors affecting workability - Measurements of workability - Various tests and procedures - Segregation and bleeding - Vibration of concrete - Types of vibrators and their influence on composition - Analysis of fresh concrete - Strength of concrete - Water-cement ratio - Gel space ratio - Effective water in the mix - Mechanical properties of concrete - Tests and procedure - Influence of various parameters on strength of concrete - Relationship between various mechanical strengths of concrete.

Unit - 2

Shrinkage and creep of concrete: Types of shrinkage - Mechanism of shrinkage - Fctors affecting shrinkage - Creep mechanism - Factors influencing creep - Rheological model - Effects of creep. Curing of Concrete: Methods of curing - Maturity concept - Influence of temperature on strength of concrete. Durability of Concrete: Permeability of concrete - Chemical attack of concrete - Tests on sulphate resistance - Effect of frost - Concreting in cold weather - Hot weather concreting and air entrained concrete, High Performance concrete.

Unit - 3.

Mix design of concrete: Basic considerations - Process of mix design - Factors in the choice of mix proportions and their influence - Quality control - Various methods of mix design - IS code method - British and ACI methods, Non Destructive Testing of Concrete.

Admixtures: Classification of admixtures - Chemical and mineral admixtures - Influence of various admixtures on properties of concrete and their applications. Fly ash concrete: Mix design - Properties and its applications. High strength concrete: Mix design - Properties and its applications. Fiber reinforced concrete: Mix design - Properties and its applications. Ferro cement - Lightweight concrete - High-density concrete - Recycled aggregate concrete and their applications.

Unit - 4.

MECHANICS OF COMPOSITES :

(a) **INTRODUCTION :** Types, Materials, definitions of lamina, laminates, etc.

(b) **BEHAVIOUR OF LAMINA :** Stress – Strain relationship for anisotropic, orthotropic and isotropic materials, transformation elastic constants, failure criterion for an orthotropic lamina introduction to micromechanics behaviour, law of mixture.

Unit - 5

BEHAVIOUR OF LAMINATE : Classical lamination theory, Stress – Strain relationship for a laminate, extensional bending coupling stiffness, Different configuration and corresponding stiffness, strength of lamina interlaminer stress.

Books & References Recommended:

1) A.M. Neville, “Properties of Concrete”, English Language Book Society-Longman Publications, 1988.
2) P.K. Mehta and J.M.M. Paulo, “Concrete – Microstructure – Properties and Material”, McGraw-Hill, New York, 1997.
3) Krishna Raju, “Design of Concrete Mix”, CBS Publications, New Delhi, 1985.
4) Concrete Technology – by *M.S.Shetty*
5) Mechanics of Composite Materials by *R.M.Jones*
6) Mechanics of Composite Materials by *J.N.Reddy*

CE 50015: Advanced Soil Mechanics & Foundation Engineering

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1) To classify different types of foundation systems & Structures
2) To discuss and evaluate feasibility of foundation solution to different types of soil conditions considering the time effect on soil behavior.
3) To build the necessary theoretical background for design, construction of foundation systems
4) To explain the principles and methodologies for designing various types of foundations, considering structural and geotechnical requirements.
5) To evaluate the suitability of foundation solutions for varying soil profiles while accounting for time-dependent soil behaviour such as consolidation and creep.

COURSE OUTCOMES: The students will be able to

1) Illustrate systematic methods for designing foundation.
2) Evaluate feasibility of foundation solution to different types of soil conditions considering the time effect on soil behavior.
3) Design of construction of foundation systems
4) Analyze and design shallow and deep foundations considering shear and settlement criteria, load-carrying capacity of piles, group action, negative skin friction, and design of pile caps and well foundations.
5) Evaluate dynamic soil parameters such as liquefaction, natural frequency, damping, cyclic loading effects, and apply them to the design of machine foundations following IS 5249 guidelines.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	1
CO4	3	2	3	3	1
CO5	3	2	3	3	2
Target	3	2	3	3	1.4

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

Unit-1 Sub Soil Exploration and Ground Improvement Techniques.

Method of Investigation, Reconnaissance and detail investigation program for different Civil Engineering Projects.

Different methods of Ground Improvement : Soil Stabilisation, Type and Methodology. Geosynthetics Reinforced Earth, Stone columns sand drains etc.

Unit-2 Shear Strength and Bearing capacity

Shear Strength : Mechanism Effective stress , State of Stress, Stress, Strain and Strain path failure theories, Skempton's Pore Pressure parameters, Hyorslev Shear Strength parameters, Sear strength characteristics of soil under undrainded and drained conditions, Shear behavuiour of dry and saturated soils, laboratory and field determination of shear parameters.

Stability of Slopes: Types of Slope Failure, Bishop's Slope Stability analysis, Stabilty number, Selection of shear parameters for analysis of geotechnical problems.

Bearing capacity: Skempton's analysis, Plate load test, Penetration tests, general bearing capacity equation and effect of water table on bearing capacity.

Unit-3 Earth Pressure

Classical theories, various types of backfill and evaluation of earth pressure, effect of submergence, Effect of surcharge and wall inclination, Condition for maximum active and passive earth pressure from sliding wedge, Rebnann's graphical construction for active passive earth pressure, Culman's graphical method.

Unit-4 Analysis and design of Foundations

Different types of shallow and deep foundations, Design of isolated, combined, strip footings and mat foundations based on shear and settlement criterion.

Different types of piles, load carrying capacity of different types of piles, group action of piles, negative skin friction, Design of pile and pile cap.Well foundation : Types, sinking of well, Components, Forces acting and design of different components, Caisson, tilt and shift

Unit-5 Dynamic Soil Parameters and Machine Foundations

Dynamic shear parameters liquefaction, factors affecting liquefaction, Natural Frequency Damped and undamped, Cyclic Plate load test, Hammer test, Coefficient of uniform compression and its importance, Block Vibration test, Different modulus of Dynamics, Design of Machine foundations, IS 5249.

Books & References Recommended:

1. Foundation Analysis & Design by J.E.Bowles
2. Basic& Applied soil – Mechanics by GopalRanjan&Rao
3. Principles of Foundations Engg. byBrajM.Das 4.
Principles of Geotechnical Engg. byBraj M. Das 5.
Geotechnical Earthquake Engg. byKsans
6.Soil Mechanics in Engg. Practice by Terzaghi M. Rech
7. Fundamentals of Soil mechanics by Taylor
8. IS 5249

CE 54459: COMPUTING TECHNIQUES LAB

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1) Discuss Numerical examples with the help of worksheets & MATLAB
2) Explain Computer fundamentals
3) Illustrate the analysis and design structures using design software
4) Apply Computational Tools for Numerical Problem-Solving
5) Implement Numerical Techniques for Engineering Problems

COURSE OUTCOMES: Students will be able to

1) Solve Numerical examples with the help of worksheets & MATLAB
2) Explain Computer fundamentals
3) Solve numerical using different numerical techniques
4) Analyze and design structures using design software
5) Discuss numerical using different numerical techniques

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	2	2	2	2	2
CO3	3	2	3	2	2
CO4	3	2	3	3	2
CO5	3	2	3	2	2
Target	2.8	2	2.8	2.2	2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

Unit – 1.

Computer Fundamentals: Computer Components, Hardware and Software, Different types of Input/Output units, Binary and Decimal Conversions.

Unit – 2.

Numerical Techniques

Unit – 3.

Numerical examples with the help of worksheets & MATLAB.

Unit – 4.

Introduction to Transportation Analysis & Design Software.

Unit – 5.

Application of Highway Design and Analysis Software.

Books & References Recommended:

- 1)BalagurusamyE.," Fundamentals of Computers"McGraw-Hill Inc.,US,2018

2) Y.K. Singh,'Matlab Programming', Prentice Hall India Learning Private Limited (2007)

SEMESTER II

CE 54516 DESIGN & CONSTRUCTION OF RIGID PAVEMENTS

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVE: At the end of the course, students will be able to

1) Design Rigid pavement.
2) Evaluate types of joints in rigid pavement.
3) Evaluate and strengthen the rigid pavement.
4) Design prestressed concrete pavement.
5) Explain the construction of rigid pavement.

COURSE OUTCOME

1. Apply Theories for Rigid Pavement Design – Analyze rigid pavement behavior using Westergaard's analysis, finite difference methods, finite element methods, and linear elastic layer theories for stress and deflection calculations.
2. Design and Analyze Pavement Joints – Evaluate different types of pavement joints, including contraction, warping, dowel bars, tie bars, and temperature reinforcements, along with joint filling and sealing techniques.
3. Design Continuously Reinforced Concrete Pavements (CRCP) – Develop CRCP designs by considering slab width and thickness, reinforcement details, crack control mechanisms, and construction criteria for highways and airfields.
4. Evaluate and Strengthen Rigid Pavements – Assess pavement performance, safety, serviceability, and durability; design overlays, including fibrous concrete overlays, and analyze the economic aspects of rigid pavement construction and maintenance.
5. Implement Construction Techniques for Rigid Pavements – Understand formwork, concrete mixing, spreading, compaction, slip-form paving, and cement concrete mix design methods tailored to pavement requirements.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	3	1
CO2	2	2	3	2	1
CO3	3	2	3	3	2
CO4	3	2	3	3	2
CO5	2	2	3	2	1
Target	2.6	2	3	2.6	1.4

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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 54517 DESIGN AND CONSTRUCTION OF FLEXIBLE PAVEMENT

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES: At the end of the course, students will be able to

1) Explain concepts of factors affecting design of pavements.
2) Design flexible pavements.
3) Explain construction of flexible pavements.
4) Evaluate and strengthen flexible pavements.
5) Evaluate pavement failures, apply remedial measures, and analyze pavement condition using various evaluation methods, including the Falling Weight Deflectometer (FWD).

COURSE OUTCOMES

1. Analyze Wheel Load Effects and Pavement Design Factors – Evaluate the impact of equivalent single wheel loads, transient and moving loads, load repetitions, and environmental factors such as frost, freezing, and thawing on pavement design.
2. Design Flexible Pavements Using Various Methods – Apply empirical, semi-empirical, and analytical methods such as CBR, California Resistance Value, Triaxial, McLeod, Burmister, and FAA methods for designing flexible pavements, including airfield pavements.
3. Explain Flexible Pavement Construction Techniques – Understand the construction processes for different types of flexible pavements, including WBM, bituminous roads, surface dressing, grouted macadam, and the Benkelman Beam method, while assessing pavement performance and cost analysis.
4. Evaluate Bituminous Binders and Mix Design – Analyze the properties, rheology, grading, and types of bituminous binders; design bituminous mixes using Marshall and Superpave methods, and compare different mix design techniques.
5. Assess and Strengthen Pavement Structures – Identify pavement failures, apply remedial measures, and evaluate pavement performance using methods such as the Falling Weight Deflectometer (FWD) for structural assessment and rehabilitation planning.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	1
CO2	3	2	3	3	1
CO3	2	2	3	2	1
CO4	3	2	3	3	2
CO5	3	2	3	3	2
Target	2.8	2	3	2.6	1.4

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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 the 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:

Bituminous Binders:Types of bituminous binders including unmodified bitumen, modified bitumen (crumb rubber modified bitumen, polymer modified bitumen), bitumen emulsion, and cutback bitumen. Tests on bitumen, physical properties, and specifications for paving bitumen.Rheology of bituminous binders: Newtonian and non-Newtonian fluids.Grading of bitumen: penetration, viscosity, and performance grading.

Bituminous Mixes:

Design of bituminous mixes using Marshall method, and superpave method. Types of bituminous mixes including hot mixes, cold mixes, warm mixes and applications.Permanent deformation, dynamic modulus, fatigue of bituminous mixes, moisture induced damage in bituminous mixes.Principles of mix Design, Factors, Method: Marshall, Habber and Field, Hveem, Triaxial, Comparison of different methods.Variousconstructionequipment and their details.

Unit-5:

Strengthening of pavement: Types of failures, remedial measurement, Pavement Evaluation Methods.Falling weight deflectometer.

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 54518 SYSTEM ANALYSIS & URBAN TRANSPORTATION

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

Course Objectives: At the end of the course, students will be able to

1) Analyse probability distributions.
2) Analysis of Carry out multivariate data and identify correlations.
3) Develop Time Series Models.
4) Estimate Parameters using appropriate techniques.
5) Test hypothesis using goodness of fit measures.

Course Outcomes:

1. Apply probability concepts and statistical measures to analyze and interpret traffic data for engineering design and decision-making.
2. Evaluate various traffic forecasting techniques and transportation planning methods to determine design hourly volume and assess future transportation needs.
3. Analyze factors influencing trip generation using regression models and category analysis for accurate travel demand estimation.
4. Utilize trip distribution and assignment models to analyze travel patterns and optimize traffic flow in transportation networks.
5. Assess the economic and environmental impact of transportation systems using cost-benefit analysis and sustainability principles.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2
Target	3	2	3	2.8	2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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, McGraw-Hill Publish.
4. Saxena, Traffic Planning and Design.
5. Bruton M.J., Introduction to Transportation Planning.

ELECTIVE I

AIRPORT INFRASTRUCTURE PLANNING AND DESIGN

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

Course Objectives: At the end of the course, students will be able to

1) Analyze the effects of atmospheric variables on aircraft performance.
2) Fix the orientation of the runways.
3) Design the geometrics of the airport infrastructure.
4) Prepare structural designs of runway, taxiway, and apron-gate area.
5) Prepare a master plan for an airport and terminal area

Course Outcomes:

1. Explain the principles of airport planning, including commercial aviation, air cargo, and general aviation, and analyze forecasting techniques such as time series, market share, and econometric modeling.
2. Analyze Aircraft Characteristics and Air Traffic Management – Examine aircraft performance parameters, atmospheric effects, and air traffic management principles, including air traffic separation rules and navigational aids.
3. Apply Geometric Design Principles to Airfield Layout – Design runways, taxiways, aprons, and control tower visibility requirements while considering classification, orientation, gradient, and separation criteria.
4. Evaluate Structural Design of Airport Pavements – Assess soil conditions, apply FAA pavement design methodologies for flexible and rigid pavements, and determine appropriate overlay solutions.
5. Design Airport Lighting, Marking, and Terminal Facilities – Develop lighting, marking, and signage plans, and apply terminal area planning principles to optimize passenger flow, apron layout, and aircraft parking.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2
Target	3	2	3	2.8	2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

UNIT-1:

Airport Planning and Forecasting: Airport planning: commercial service aviation, air cargo, and general aviation; civil aviation airports; major acts and policies of the Ministry of Civil Aviation in India. Aviation organizations and functions: Federal Aviation Administration, International Civil Aviation Organization, Directorate General of Civil Aviation, Airports Authority of India. Airport planning studies: airport system plan, airport site selection, airport master plan, airport project plan; continuous planning process. Forecasting methods: time series method, market share method, econometric modelling. Forecasting requirements and applications.

UNIT-2:

Aircraft Characteristics: Landing gear configurations, aircraft weight, engine types. Atmospheric conditions affecting aircraft performance: air pressure, temperature, wind speed and direction. Aircraft performance characteristics: speed, payload and range, runway performance, declared distances, wingtip vortices. Air Traffic Management: Air traffic separation rules: vertical separation, flight altitudes, longitudinal separation, and lateral separation. Navigational aids: ground based systems, satellite based systems.

UNIT-3:

Geometric Design of the Airfield: Airport classification: utility airports, transport airports. Runways: runway configurations, runway orientation, wind rose, estimating runway length, sight distance and longitudinal profile, transverse gradient, airfield separation requirements, obstacle clearance requirements. Taxiways and taxi lanes: widths and slopes, taxiway and taxi lane separation requirements, sight distance and longitudinal profile, exit taxiway geometry, location of exit taxiways, design of taxiway curves and intersections, end-around taxiways. Aprons: holding aprons, terminal aprons and ramps, terminal apron surface gradients. Control tower visibility requirements.

UNIT-4:

Structural Design of Airport Pavements: Soil investigation and evaluation: CBR, plate bearing test, Young's modulus, effect of frost on soil strength, subgrade stabilization. FAA pavement design methods: equivalent aircraft method, cumulative damage failure method. Design of flexible pavements: CBR method, layered elastic design. Design of rigid pavements: Westergaard's

analysis, finite element theory, joints and joint spacing, continuously reinforced concrete pavements. Design of pavement overlays.

UNIT-5:

Airport Lighting, Marking, and Signage: Requirements of visual aids, approach lighting system configurations, visual approach slope aids, threshold lighting. Runway lighting, taxiway lighting. Runway and taxiway marking, airfield signage. Planning and Design of the Terminal Area: Passenger terminal system and its components. Design considerations: terminal demand parameters, facility classification, level of service criteria. Terminal planning process: overall space requirements, concept development, horizontal distribution concepts, vertical distribution concepts. Apron gate system: number of gates, ramp charts, gate size, aircraft parking type, apron layout, apron circulation, passenger conveyance to aircraft, apron utility requirements.

Books & Reference Recommended:

1. Ashford, N. J., Mumayiz, S. A., and Wright, P. H. Airport Engineering: Planning, Design and Development of 21st Century Airports, Fourth Edition, John Wiley & Sons, New Jersey, USA, 2011.
2. Horonjeff, R., McKelvey, F. X., Sproule, W. J., and Young, S. B. Planning and Design of Airports, Fifth Edition, McGraw-Hill, New York, USA, 2010.
3. Kazda, A., and Caves, R. E. Airport Design and Operation, Second Edition, Elsevier, Oxford, U.K., 2007.
4. Khanna, S. K., Arora, M. G., and Jain, S. S. Airport planning and Design, Sixth Edition, Nem Chand and Bros, Roorkee, India, 2012.
5. Kumar, V., and Chandra, S. Air Transportation Planning and Design, Galgotia Publications Pvt. Ltd., New Delhi, India, 1999.
6. Neufville, R. D., and Odoni, A. Airport Systems: Planning, Design, and Management, McGraw-Hill, New York, USA, 2003.
7. Young, S. B., and Wells, A. T. Airport Planning and Management, Sixth Edition, McGraw-Hill, New York, USA, 2011.

CE 54212: FINITE ELEMENTS METHOD

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1) Explain different steps and approaches to solve a problem using FE method.
2) Dfine the behaviour and uses of different types of elements.
3) Develop the solution in many points as much as we want of an object by discretizing the object.
4) Derive the element stiffness matrix for 1-D, 2-D and 3-D problems.
5) Formulate the simple structural problems into finite elements.

COURSE OUTCOMES: The students will be able to

1) Build and analyse the FEA models for various engineering problems.
2) Identify the information requirements and sources for analysis, design and evaluation.
3) Solve the structural engineering problems using the standard finite element.
4) Interpret the results obtained from FEA software, not only in terms of conclusions but also awareness of limitations.
5) Develop the use of computer to solve complex problem along with applied· boundary conditions using FE method.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	2	2
CO3	3	2	3	3	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2
Target	3	2	3	2.6	2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

Unit – 1.

INTRODUCTION TO FINITE ELEMENT METHOD : General Applicability and Description of Finite Element Method comparison with other Methods.

Unit – 2.

SOLUTION OF FINITE ELEMENT METHOD : Solution of Equilibrium Problems, Eigen value problems, propagation problems, computer implementation of Gaussian eliminations, Choleski's decomposition, Jacobi's and RangaKutta Method.

Unit – 3.

GENERAL PROCEDURE OF FINITE ELEMENT METHOD : Discretization of the domain, Selection of Shapes, types and number of elements, node numbering technique, Interpolation Polynomials, their selection and derivation in terms of global and local coordinates, Convergence requirements. Formulation of Element Characteristic matrices and vectors, Variational approach.Assembly of Element matrices and Vectors and Derivation system equations, computation of element resultants.

Unit – 4.

ISOPARAMETRIC FORMULATION : Lagrange and Hermite interpolation functions, Isoparametric Elements. Numerical Integration.

Unit – 5.

STATIC ANALYSIS : Formulation of equilibrium equations, Analysis of truss, Frames, Plane Stress and Plane Strain Problems Plates and Shells.

Books & References Recommended:

1) R.D. Cook, "Concepts and Application of Finite Element Analysis", John Wiley and Sons, 1981.
2) O.C. Zienkiewicz and R.L. Taylor, "The Finite Element Method, Volume 1: The Basis", McGraw-Hill, London, 1989.J.N. Reddy, "An Introduction to the Finite Element Method", McGraw-Hill, New York, 1993.
3) David V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill, New Delhi, 2005.
4) K.J. Bathe, "Finite Element Procedures", Prentice Hall of India, New Delhi, 2006.
5) T.R. Chandrupatla and A.D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India, New Delhi, 2001.
6) P. Seshu, "Finite Element Analysis", Prentice Hall of India, New Delhi, 2003.

CE 54213 : INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1. Explain and analyse generalized measurement systems, calibration, sensitivity, and various standards of measurement for different quantities.
2. Illustrate the construction and working principles of various transducers for measuring temperature, vibration, force, velocity, torque, and pressure.
3. Apply photoelasticity techniques to analyse stress distribution using isoclinic, isochromatic, and 3D stress-freezing methods.
4. Utilize Moiré Fringe techniques for strain, displacement, rotation, and slope measurements in plane and out-of-plane structural analysis.
5. Analyze model studies using laws of similitude, Buckingham Pi theorem, and evaluate accuracy, reliability, and size effects in structural model analysis.

COURSE OUTCOMES: The students will be able to

1. Explain the principles of measurement systems, calibration, sensitivity, and standards for various physical quantities, along with the working principles of mechanical, hydraulic, electrical, and electronic systems.
2. Examine the construction and functioning of different transducers, including temperature, vibration, force, velocity, torque, and pressure measurement devices.
3. Utilize photoelastic methods, including polariscope analysis, stress-optic relations, calibration techniques, and 3D photoelasticity for stress measurement in structural components.
4. Analyze Moiré fringe patterns to measure strain, displacement, rotation, and slope in in-plane and out-of-plane problems.
5. Apply principles of structural similitude, non-dimensional analysis, and Buckingham Pi theorem for predicting prototype behavior, assessing size effects, and ensuring model accuracy and reliability.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	2	2
CO3	3	2	3	3	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2
Target	3	2	3	2.6	2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

Unit – 1.

Generalized measurement systems, calibration and sensitivity.Standards of measurements of various quantities.Detectors : Sensor system elements, transducer and devices, Different types of sensors, Modifying and transmitting method. Mechanical, Hydraulic, Electrical and Electronic System.

Unit – 2.

Construction details of : Temperature transducers, vibration and shock measurement. Vibration pick-ups, Force and Load transducers, Velocity transducers, Torque transducers, Pressure measurements and pressure transducers.

Unit – 3.

Photo elasticity : Basic optics and polariscope Photo elastic effect: Stress-optic relations, Isoclinics. Isochromatics, Calibration of model, Separation techniques. Fractional Fringe order determination, Analysis of photoelastic data. Introduction to 3D Photoelasticity, Stress Freezing techniques, Slicing Tech. And Scattered light photo elasticity.

Unit – 4.

Moiré Fringe Technique: Moiré phenomenon, Analysis of Moiré fringes. Measurement of strain, displacement, rotations and slope for in plane and out of plane problems.

Unit – 5.

Model Analysis : Different types of model, Laws of structural similitude and non-dimensional analysis, Buckingham Pi theorem, Predictions for prototype, size effect, Applications. Accuracy and reliability of structured models.

Books & References Recommended:

1. Dalley .J.W and Riley.W.F, “Experimental Stress Analysis”, McGraw Hill Book Company, N.Y. 1991
2. Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.
3. Ravisankar.K.andChellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures”, SERC, Chennai, 2007.
4. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.
5. Sirohi.R.S.,Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997.

ELECTIVE II

CE 54214 Railway & airport Infrastructure Planning & Design

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

Course Objectives

1. Analyze Railway Network Planning – Study historical developments, alignment, traffic forecasting, and project appraisal.
2. Apply Geometric Design Principles – Design railway tracks considering gradients, cant, grade compensation, and curve speed.
3. Explain Track Construction & Maintenance – Evaluate mechanized methods, drainage, track renewal, and bridge maintenance.
4. Assess Railway Safety & Signaling – Examine signaling, interlocking, accident prevention, and disaster management.
5. Evaluate Railway Stations & High-Speed Rail – Analyze station planning, modernization, and high-speed rail impacts.

Course Outcomes: At the end of the course, students will be able to

1) Analyze railway network planning by understanding historical developments, operational systems, railway alignment, traffic forecasting, and project appraisal methods.
2) Apply geometric design principles for railway tracks, including right of way, gradients, cant, grade compensation, and speed computation on curves.
3) Explain railway track construction and maintenance by evaluating mechanized methods, track drainage, track renewal, and bridge maintenance techniques.
4) Assess railway signaling, interlocking, and safety measures to prevent train accidents, collisions, and derailments, including disaster management strategies
5) Evaluate railway station facilities and high-speed rail systems including site selection, classification, modernization, and the effects of high-speed tracks on vehicle performance.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	2	2
CO3	3	2	3	2	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2
Target	3	2	3	2.4	2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Unit-1:

Planning of railway lines network Railways operational system, historical background of Indian railways, plans and developments, policy and standards, traffic forecast and surveys, railway alignment, project appraisal and organization setup. Component of railway track and rolling stock: Permanent way, forces acting, rails, function of rails, rail fixtures and fastenings, sleepers and ballast, rail joints, elements of junctions and layouts, types of traction, locomotives and other rolling stock, brake systems, resistance due to friction, wave action, wind, gradient, curvature, starting, tractive effort of a locomotive, hauling power of a locomotive.

Unit-2:

Geometric design of railway track: Right of way and formation, field investigation, geometric design elements, safe speed on curves, speeds computation, string lining of curves, gradients, grade compensation, railway cant and cant deficiency, traction.

Unit-3:

Track construction and maintenance Special considerations and construction practices, track laying, inspection and maintenance, maintenance tools, maintenance of rail surface, track drainage, track circuited lengths, track tolerances, mechanized method, off-track tampers, shovel packing, ballast confinement and directed track maintenance, bridge maintenance, renewal, classification of renewal works, through sleeper renewals, mechanized relaying, track renewal trains.

Unit-4:

Signaling and interlocking: Objectives, classification, fixed signals, stop signals, signaling systems, mechanical signaling system, electrical signaling system, systems for controlling train movement, interlocking, modern signaling installations.

Railway accidents and safety: Train accidents, collision and derailments and their causes, restoration of traffic, safety measures, disaster management, classification of level crossings, accidents at level crossings, remedial measures, maintenance of level crossings.

Unit-5:

Railway Station and Yards: Site selection, facilities, classification, platforms, building areas, types of yards, catch sidings, ship sidings, foot over bridges, subways, cranes, weigh bridge, loading gauge, end loading ramps, locomotive sheds, ash-pits, water columns, turntable, triangles, traverse,

carriage washing platforms, buffer stop, scotch block, derailing switch, sand hump, fouling mark.

High Speed Railways: Modernization of railways, effect of high speed track, vehicle performance on track, high speed ground transportation system, ballastless track, elevated railways, underground and tube railways.

Books & Reference Recommended:

1. Clifford F. Bonnett, Practical Railway Engineering, 2nd Edition, Imperial College Press, London, 2005. 2. Gupta, B.L. and Amit Gupta, Railway Engineering, Third Edition, Standard Publishers, New Delhi, India, 2005
2. J.S. Mundrey, Railway Track Engineering, Fourth Edition, Tata McGraw-Hill Education Private Limites, New Delhi, 2010.
3. Rangwala, S.C. Railway Engineering, Charotar Publishing House, Anand, India, 2008.
4. S.C. Saxena and S.P. Arora, A textbook of Railway engineering, Sixth Edition, DhanpatRai Publications, 2001.
5. Satish Chandra and M. Agrawal, Railway Engineering, Second Edition, Oxford University Press, 2013. 7. William W. Hay, Railroad Engineering, Second Edition, John Wiley & Sons, New York, 1982.

CE 54312 :QUALITY AND SAFETY IN CONSTRUCTION

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1. To explain the concept of QC (quality control), quality assurance (QA) and TQM (total quality management).
2. To illustrate the concept of the international quality standard ISO 9001.
3. To discuss the measurement quality costs of construction processes.
4. To illustrate the importance of safety management in construction and the reduction of accidents on construction sites.
5. To apply safety management systems for construction and working on sites of high rise construction, deep excavation.

COURSE OUTCOMES: The students will be able to

1. To explain the concept of QC (quality control), quality assurance (QA) and TQM (total quality management).
2. To define the concept of the international quality standard ISO 9001.
3. To measure quality costs of construction processes.
4. To illustrate the importance of safety management in construction and the reduction of accidents on construction sites.
5. To apply safety management systems for construction firms and their sites and to understand the relationship between safety investment and the financial, social and pain & suffering costs of construction accidents

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	2	2
CO3	3	2	3	3	2
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Target	3	2	3	2.6	2.4

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

Unit –1

Concept of Quality: Definition of quality as given by Deming, Juran, Crosby, difference between Quality control, Quality Assurance (QA/QC). Total quality control (TQC) and Total Quality Management (TQM), Need for TQM in construction industry. Organization necessary for implementation of quality, Quality manual-Contents, data required, preparation, responsibility matrix, monitoring for quality- PDCA Cycle. Quality aspects in every phase in the life cycle of Construction project.

Quality Control tools and statistical quality Control: (A) Histogram, Pareto diagram, Fishbone diagram, Quality control chart-Testing required for quality control of construction material used in RCC Work-destructive and Non destructive Test (NDT) (B) Statistical Quality Control- Necessity, Benchmarking, Application of dispersion methods in quality control of construction activity.

Training and development of Human Resources: Training needs assessment, technical and managerial competencies necessary for achieving quality, preparation for training. Training on Project Rework Reduction Tool (PRRT) software- training for preparation of checklist necessary for RCC work, for commonly used formats.

Unit-2

Development of quality circles, quality inspection team, inspection reports, monitoring and control, 360‘ feedback for quality.

Study of ISO 9004- Quality System Standards.Purpose of ISO Standards.Difference between ISO 9001 and ISO 9004.Certification process for ISO 9001. Certification bodies involved. Eight Principles of ISO-Basic meaning, applying these principles for an effective quality process in the organization.Management support and commitment necessary for achieving implementation for quality system standards.

Achieving TQM on Construction Projects: Advantages, barriers, principles, steps in implementation, seven types of construction defects.Determining cost of poor quality including hidden cost. Quality functions deployment (QFD). Importance of third party quality audits. CIDCCQRA quality rating systems, customers satisfaction surveys, Non Conformity reports (NCR), remedial strategy for reducing NCR‘s.

Unit 3

Construction Safety Management – Role of various parties, duties and responsibilities of top management, site managers, supervisors etc. role of safety officers, responsibilities of general employees, safety committee, safety training, incentives and monitoring. Writing safety manuals, preparing safety checklists

and inspection reports.

Unit 4

Safety in construction operations – Safety of accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, etc. safety at various stages of construction. Prevention of accidents.Safety measures.Safety in use of construction equipment e.g. vehicles, cranes, hoists and lifts etc. safety of scaffolding and working platforms.Safety while using electrical appliances. Explosives used.

Unit 5

Various safety equipment and gear used on site. First aid on site, Safety awareness program. Labour laws, legal requirement and cost aspects of accidents on site, Incentive for safety practices. Study of safety policies, methods, equipment, training provided on any ISO approved construction Company ,safety in office, working on sites of high rise construction, deep excavation.

Books & References Recommended:

1) International Standards Organization – ISO 9001 and ISO 9004
2) Mantri Handbook – A to Z of Construction – Mantri Publications
3) Juran‘s Quality Handbook – Joseph M. Juran, A. Blanton. Godfrey – Mcgraw Hill International Edition (1998).
4) Probability and Statistics for Engineers – Miller, Freund-Hall, Prentice India Ltd.
5) Quality Control and Total Quality Management, P.L.Jain, Tata Mcgraw Hill Publ.
6) Construction safety manual published by National Safety Commission of India.
7) Safety Management in Construction Industry – A manual for project managers. NICMAR Mumbai.
8) Construction Safety Handbook – Davies V.S.Thomasin K, Thomas Telford, London.
9) ISI for safety in Construction – Bureau of Indian Standrads.
10) Safety management‖ –Girimaldi and Simonds, AITBS, New Delhi.

CE 54313 : RESEARCH METHODOLOGY

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100

COURSE OBJECTIVES: The students will be able to

1) Illustrate the research types and methodology.
2) Do literature survey using quality journals.
3) Collect research data.
4) Process research data to write research report for grant proposal

COURSE OUTCOMES:

1) Discuss the research types, methodology and formulation. Identify the sources of literature, survey, review and quality journals.
2) Discuss the research design for collection of research data.
3) Analyze the research data and write the research report and grant proposal.
4) To identify and apply appropriate research methodology in order to plan, conduct and evaluate basic research.
5) To compare between the scientific method and common-sense knowledge while laying the foundation for research skills at higher levels.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	3	3	2	3
CO2	3	3	3	2	3
CO3	2	3	3	3	3
CO4	3	3	3	3	3
CO5	3	2	3	2	3
Target	2.8	2.8	3	2.4	3

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

I. Research: a) Types, Research process and steps in it, hypothesis, Research proposals and aspects. Research Methodology: Objectives of Research, Motivation in Research, Types of Research, Research Approaches, and Significance of Research. Research Methods Versus Methodology, Research and Scientific Method, Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem..

b) Research Design: Need, Problem Definition, variables, research design concepts, Literature .survey and review, Research design process, Errors In research. Data Collection and Representation: Primary Data Secondary Data, Data Presentation. Processing and Analysis of Data: Statistics in Research, Measures of Central Tendency,.Measures of Dispersion (variation), Measures of Asymmetry (Skewness), Measures of Relationship, Forecasting, Linear Regression and Time series.

c) Sampling Methods and Distributions: Sampling Methods, Sampling Distribution of mean, Sampling Distributions of Variance. Testing of Hypotheses-I : Basic Concepts Concerning Testing ofHypotheses, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Important Parametric Tests, Limitations of the Tests of Hypotheses, Chi-square Test, Non Parametric Tests.

d) Research. Modelling: Types of Models, Model building and stages, Data consideration and testing; Heuristic and Simulation modelling, Simulation: Need for simulation, Types of' Simulation: Simulation languages.

e) Report Writing: Pre writing considerations,, Thesis writing, Formats of report writing, Formats of publications in Research journals. Technique of Interpretation, Precaution inInterpretation,Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Report Format', Typing Instructions, Oral Presentation.

II. Design of Experiments: a) Objectives; strategies, Factorial experimental design, Designing engineering experiments, basicprinciples-replication, randomization, blocking, Guidelines for design of experiments.

b) Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components. Model adequacy checking. c) Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two-factor factorial design; Models-Effects, means and regression. Hypothesis testing.

Books & References Recommended:

1) C.R Kothari, “Research Methodology, Methods & Technique”, New Age International Publishers, New Delhi, 2004.
2) R. Ganesan, “Research Methodology for Engineers”, MJP Publishers, Chennai, 2011.
3) RatanKhananabis and SuvasisSaha, “Research Methodology”, Universities Press, Hyderabad, 2015.
4) Y.P. Agarwal, “Statistical Methods: Concepts, Application and Computation”, Sterling

Publishing Pvt. Ltd., New Delhi, 2004.
5) Vijay Upagade and AravindShende, “Research Methodology”, S. Chand & Company Ltd., New Delhi, 2009.
6) G. NageswaraRao, “Research Methodology and Quantitative methods”, BS Publications, Hyderabad, 2012.
7) R.Panneerselvam , Research Methodology, PHI
8) Ranjit Kumar, Research methodology: a step-by-step guide for beginners, SAGE Publication. Ltd.
9) Montgomery, Douglas C;(2007), 5/e, Design and Analysis of Experiments, Wiley India)
10) Montgomery, Douglas C. &Runger; George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley Endia)
11) Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

ELECTIVE III

CE 54314 BRIDGE AND TUNNEL ENGINEERING

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

Course Objectives:

1. Classify and Analyze Bridges – Understand bridge types, components, site selection factors, loads, and structural behavior.
2. Apply Design Standards – Utilize IRC codes, design loads, traction forces, and temperature effects in bridge design.
3. Design Bridge Superstructures – Apply Courbon's and Pigeaud's theories to design solid slab, girder, and balanced cantilever bridges.
4. Design Bridge Substructures & Bearings – Design piers, abutments, bearings, and steel bridges under railway loading.
5. Illustrate Tunnel Engineering – Analyze tunnel classification, alignment, construction methods, safety, and drainage systems.

Course Outcomes:

1. Analyze the classification of bridges based on materials, structural behavior, span, substructure, and purpose. Evaluate site selection factors, hydrology, and various loads acting on bridges, including maintenance and strengthening techniques.
2. Apply standard specifications and design codes for road bridges, incorporating IRC loading standards, traction forces, temperature effects, and economic span considerations.
3. Design solid slab and girder slab bridges using Courbon's and Pigeaud's theories, as well as balanced cantilever bridges with articulations and suspended spans.
4. Design supporting structures, piers, abutments, and bearings for bridges, including solid and hollow piers, single and multi-cellular piers, and rocker/roller bearings for steel truss and girder bridges.
5. Evaluate tunneling methods and safety considerations, including alignment, portal and shaft construction, drainage, ventilation, lighting, and dust control in various ground conditions.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	2	1
CO2	3	0	3	2	0
CO3	3	1	3	2	1
CO4	3	2	3	3	3
CO5	3	0	3	3	1
Target	3	0.8	3	2.4	1.2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content-

Unit - 1

Bridges: Classification of bridges – with respect to construction materials, structural behavior of super structure, span, sub structure,purpose. Temporary and movable bridges.Factors affecting site selection.Various loads/stresses acting on bridges.Bridge hydrology –design discharge, water way, afflux, scour depth, economical span.

Bridge components – foundation, piers, abutments, wing wall, approach, bearings, floor, girders, cables, suspenders.Methods of erection of different types of bridges.River training works and maintenance of bridges. Testing and strengthening of bridges. Bridge architect.

Unit - 2

Standard Specifications and Code of practice for general requirements of Road Bridges. Design loads for Bridges, IRC loading Standards, Traction Forces and Temperature Effect. General Design requirements. Economic Span of Bridge.Various Types of Bridges.

Unit - 3

Design of Solid Slab and Girder Slab Bridges, Courbon's Theory and Pigeaud' Theory for design of Girders and Slabs.

Design of Balanced Cantilever Bridges. Design of Cantilever section, Suspended Span and Articulations.

Unit - 4

Design of Supporting Structures, Piers and Abutments, Solid and Hollow Piers. Single Cellular and Multi Cellular Piers, Design of Bearings. Introduction of Continuous and Arch Bridges. Steel Bridges subjected to Railway Loading, Truss Bridges, Girder Bridges, Design of Rocker and Roller Bearing.

Unit - 5

Tunnels: Necessity/advantage of a tunnel, Classification of Tunnels, Size and shape of a tunnel, Alignment of a Tunnel, Portals and Shafts,Methods of Tunneling in Hard Rock and Soft ground, Mucking, Lightingand Ventilation in tunnel, Dust control, Drainage of tunnels, Safety in tunnel construction.

Book & References Recommended :

1) D.J. Victor, Essential of Bridge Engineering, Oxford & IBH Pub. Co. Ltd. Mumbai
2) Aswani M.G., Vazirani V.N., Ratwani M.M., Design of Concrete Bridges.
3) Ratwani M.M., Steel Structures Vol. III.
4) Ponnuswamy S., Bridge Engineering
5) Satish Chandra and M.M. Agrawal, Railway Engineering, Oxford University Press, New Delhi
6) S.P. Bindra, Principles and Practice of Bridge Engineering, DhanpatRai& Sons, New Delhi
7) S.C. Saxena, Tunnel Engineering, DhanpatRai& Sons, New Delhi

CE 54712 INTELLIGENT TRANSPORTATION SYSTEMS

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

Course Objectives

1. Illustrate ITS Fundamentals – Explain definitions, objectives, taxonomy, and applications of ITS.
2. Analyze ITS User Services – Evaluate infrastructure-based and vehicle-based ITS applications.
3. Assess ITS Components & Strategies – Examine ATMS, traveler information, and electronic payment systems.
4. Design & Implement ITS Solutions – Utilize data acquisition, communication tools, and detection technologies.
5. Explore ITS Standards & Future Trends – Interpret legal, financial, and integration challenges in ITS development.

Course Outcomes: At the end of the course, students will be able to

1. Explain the fundamentals of ITS, including definitions, features, objectives, history, taxonomy, and telemetric systems, along with their applications in transportation.

2. Analyze various ITS user services, including infrastructure-based services (arterial/freeway management, safety, emergency response, electronic payment) and intelligent vehicle-based services (collision avoidance, driver assistance).

3. Evaluate ITS components, tools, and strategies, including advanced traffic management systems (ATMS), traveler information systems, electronic payment, rural and urban traffic control systems, and their benefits/limitations.

4. Design and implement ITS solutions by selecting appropriate data acquisition methods, communication tools (DSRC, CALM), vehicle detection technologies, and analyzing global ITS case studies.

5. Interpret ITS standards and future developments, including legal and financial considerations, integration challenges, and the mainstreaming of ITS for future transportation innovations.Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	3	3	3	2
CO5	3	3	3	3	3
Target	3	2.4	3	2.8	2.2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

UNIT 1

ITS Background and Telemetric systems:

Definitions, features and objectives of ITS, History of ITS and its development over the world, telemetric concept, transport telemetric, telemetric structure, ITS taxonomy, ITS application areas, uses, and application overview.

UNIT 2

ITS User Services:

infrastructure based services; Arterial management and integration, freeway/highway management, crash prevention and safety, road weather management, roadway operation and maintenance, transit management, emergency management, Electronic payment and pricing, traveller information, COV, etc., Intelligent vehicle based services; collision notification and avoidance system, driver assistance system, and examples.

UNIT 3

ITS components, tools and strategies:

Components of user services; advanced traffic management system, advanced traveler information systems, advanced vehicle control system, commercial vehicle operational management, advanced public transportation system, electronic payment system, advanced rural transportation, security and safety systems, urban traffic control, scoot and scat systems, benefits and limitations.

UNIT 4

Design and implementation:

Design components; data acquisition methods, equipment and used technology, radar and sensors, detectors, vehicle identifiers, and GPS, Communication tools; DSRC, CALM, traveler information tools, data handling, processing and management; TCM, and its working, worldwide ITS implementation and challenges, case studies.

UNIT 5

ITS Standards and future scope:

ITS standards, development process, legal issues, financial issues, Mainstreaming ITS; integration and up gradation; Future of ITS, case studies.

Books & Reference Recommended:

1. AUSTROADS, The Implication of Intelligent Transport Systems for Road Safety, Austroads Incorporated, 1999. 2. Bob Williams, Intelligent Transport Systems Standards, Artech House Publishers, 2008.
2. 56
3. Chowdhury, M. A. and Sadek, A, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2003.
4. E. Bekiaris and Y.J. Nakanishi, Economic Impacts of Intelligent Transportation Systems: Innovations and Case Studies, Elsevier/JAI, 2004. 5. IET Intelligent Transport Systems and 15th International IEEE Conference on Intelligent Transportation Systems (ITSC), 16-19 September, 2012. (http://digital-library.theiet.org/content/journals/iet-its)
5. J.M. Sussman, Perspectives on Intelligent Transportation Systems (ITS), Springer, 2005
6. L. Vlacic, M. Parent, F. Harashima, Intelligent Vehicle Technologies – Theory and Applications, Butterworth-Heinemann, 2010.
7. M.A. Chowdhury and A. Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2010.
8. R. Stough, Intelligent Transport Systems: Cases and Policies, Edward Elgar, 2001, Artificial Intelligence and Intelligent Transportation Systems, National Academy Press, 2010.

CE 5 4 7 1 3 : ANALYSIS AND DESIGN OF BRIDGES

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1) Explain the fundamentals and codes of practice of bridge design.
2) Design the bridge deck and box girder systems using appropriate method.
3) Design the steel truss and composite steel-concrete bridges.
4) Propose the sub-structure components such as pier, abutments, etc. and bridge bearings.
5) Design the various types of long span bridges, curved and skew bridges.

COURSE OUTCOMES: The students will be able to

1. Evaluate different types of bridges, materials, loading standards, and site selection criteria for efficient bridge planning and design.
2. Design and analyze RCC slab and girder bridges using various slab design methods, including box girder systems.
3. Design steel and composite bridges, including plate girder, truss, and orthotropic deck systems, while understanding their structural behavior.
4. Analyze and design bridge substructures, including piers, abutments, foundations, bearings, and expansion joints, ensuring structural stability.
5. Apply design principles for long-span bridges, including cable-stayed and suspension bridges, and explore modern construction, maintenance, and seismic-resistant techniques.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	3	3	3	2
CO5	3	3	3	3	3
Target	3	2.4	3	2.8	2.2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

Unit – 1.

General : Loadings and types of bridges, Site Selection, Economic Span. Introduction: Types of bridges - Materials of construction - Codes of practice (Railway and Highway Bridges) - Aesthetics - Loading standards (IRC, RDSO, AASHTO) - Recent developments box girder bridges - Historical bridges (in India and overseas). Planning and layout of bridges: Hydraulic design - Geological and geo- technical considerations - Design aids - Computer softwares- Expert systems.

Unit – 2.

R.C.C. : Design of simply supported solid slab bridge and girder bridge. Concrete bridges: Bridge deck and approach slabs - Slab design methods - Design of bridge deck systems - Slab-beam systems (Guyon-Massonet and Hendry Jaeger methods) - Box girder systems - Analysis and design - Detailing of box girder systems.

Unit – 3.

Steel : Design of Plate Girder and truss bridge (with Orthotropic deck). Steel and composite bridges: Introduction to composite bridges - Advantages and disadvantages - Orthotropic decks - Box girders - Composite steel-concrete bridges - Analysis and design - Truss bridges. Behaviour of R.C.C. and Steel Box-Girder Bridges.

Unit – 4.

Sub-structure: Piers - Columns and towers - Analysis and design - Shallow and deep foundations - Caissons - Abutments and retaining walls. Bridge appurtenances: Expansion joints - Design of joints - Types and functions of bearings - Design of elastomeric bearings - Railings - Drainage system - Lighting.

Unit – 5.

Bearings, Piers and Abutments. Long span bridges: Design principles of continuous box girders - Curved and skew bridges - Cable stayed and suspension bridges - Seismic resistant design - Seismic isolation and damping devices. Construction techniques: Cast in-situ - Prefabricated - Incremental launching – Free cantilever construction - Inspection - Maintenance and rehabilitation - Current design and construction practices. Introduction to pre-stressed bridge

Books & References Recommended:

1) Wai-Fah Chen LianDuan, "Bridge Engineering Handbook", CRC Press, USA, 2000.
2) R.M. Barker and J.A. Puckett, “Design of Highway Bridges”, John Wiley & Sons, New York, 1997.
3) P.P. Xanthakos, "Theory and Design of Bridges", John Wiley & Sons, New York, 1994.
4) D.J. Victor, “Essentials of Bridge Engineening,” Oxford & IBH Publishing, New Delhi, 2001.
5) N. Krishna Raju, “Design of Bridges,” Oxford & IBH Publishing, New Delhi, 1998.
6) T.R. Jagadeesh and M.A. Jayaram, “Design of Bridge Structures,” Prentice-Hall of India, New Delhi, 2006.

ELECTIVE IV

CE 54761 TRANSPORTATION PLANNING AND INFRASTRUCTURE DESIGN

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

Course Objectives:

1. Analyze the role of transportation in civilization and its economic.
2. Evaluate continuous flow systems and terminal operations using queuing theory.
3. Apply cost estimation methods, demand models.
4. Assess the environmental impacts of transportation and implement operational strategies, traffic management schemes, and intelligent transport systems for congestion reduction and system efficiency.
5. Design road geometric features based on topography, traffic conditions, and international standards, with a focus on Low Volume Roads (LVRs) and hill road standards.

Course Outcomes: At the end of the course, students will be able to

1. Explain the role of transportation in civilization and its economic, social, political, and environmental impact, emphasizing the components of the transportation system.
2. Analyze continuous flow systems and terminal operations, including simulation, queuing theory, and service level concepts.
3. Evaluate transport costs, demand, and supply relationships using economic models, forecasting techniques, and pricing strategies.
4. Assess environmental impacts of transportation systems and develop operational plans incorporating traffic management and intelligent transport systems (ITS).
5. Apply geometric design principles for low-volume roads (LVRs), hill roads, and cross-drainage works using national and international standards.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	3	2
CO3	3	3	3	3	2
CO4	3	3	3	3	3
CO5	3	2	3	3	2
Target	3	2.4	3	2.8	2.2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Unit-1.

Transportation in Society: Role of transportation (Land, air, water) in civilization, Economic, social, political, environmental roles of transportation today in India.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-2.

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-3:

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.

Unit-4:

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

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, Intelligent Transport System.

Unit-5:

Geometric design: Topography and physical features, traffic, geometric design standards for LVRs with special reference to PMGSY, Hill road standards, Design concepts and criteria, cross sectional elements, LVRs Internationally, recommendations, cross drainage works, horizontal alignment, vertical alignment and traffic engineering requirements, international experience and various countries standards on LVRs geometric designs.

Books & Reference Recommended:

1. Edward K. Morlok, Introduction to Transportation Engineering an Planning, McGrawHill Book Co.
2. John W. Dickey, Metropolitan, Transportation Planning, McGraw 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, McGraw Hill Book Co.
5. Hutkinson, Bruce D., Principles of Urban Transport System Planning, McGraw Hill.

CE 54762 Advance Construction Practices

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1) Discussion on various power generating structures.
2) Explain construction techniques of bridges
3) Explain different methods and techniques of construction of Underground and over ground structures
4) Illustrate techniques of construction of high-rise building
5) Techniques of construction of offshore structures

COURSE OUTCOMES: The students will be able to

1) Explain construction techniques of various power generating structures.
2) Explain construction techniques of bridges
3) Explain different methods and techniques of construction of Underground and over ground structures
4) Illustrate techniques of construction of high-rise building.
5) Techniques of construction of offshore structures

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	2
CO2	3	2	3	3	2
CO3	3	3	3	3	2
CO4	3	3	3	3	3
CO5	3	2	3	3	2
Target	3	2.4	3	2.8	2.2

6) **Legends**

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

7)

8)

Theory Content:

Unit 1

Construction of power generating structures – Atomic Power stations, Thermal power stations. Co - generation Power Plant, Windmills, Transmission towers, Chimneys (single and multi-flue), cooling towers - Natural draft cooling towers (NDCT) & induced draft cooling tower (IDCT), Ash handling system, Containment Structure, Electro Static Precipitator (ESP), Case study of Kaiga atomic power station, Madras atomic power station. Or Any other Case Study and Safety Hazards

Unit 2

Bridges, Steel Bridges, Arch Bridges, Cantilever Bridges Segmental construction & Box Girders. Construction of special type of bridges such as cable stayed bridge, suspension and pre-stressed bridge, construction of foundation and Super structure.

Unit 3

Construction of Metro Railway & Monorail - Underground and over ground structures, different methods and techniques of construction. Problems and solutions – during maintenance and upkeep of structures. Fire, Ventilation, Dewatering and power supply, Subsidence, Vibration etc., Concept of Magrail.

Unit 4

High rise buildings – Construction methods and techniques using different materials, Minerals, Admixtures in-situ concrete, Precast Concrete & Structural Steel, finished concrete, tunnel form, fire Fighting, Safety & Hazards, Job Safety Analysis. Innovative methods of construction – Slip form technology, Jump form technology, Aluform& Tunnel Form Technology, Dry wall technology, Plastering Machines.

Unit 5

Offshore structure such as- Beacons, Oil drilling Platforms, light houses. Barges- Jackup Platform, Deck Barge, Hydro clam barges, Hoppers Barges, Submersible barges, Function, utilization & economics of barges.

Dredging System, Mechanism, Hydraulic dredger in waves, Water & Booster System, Dredging in navigation system, Agitation dredging system, silt dredging system, water injection system, Pneumatic dredging system, Amphibious & scrapper dredging system, Advantages & Disadvantages of Various Dredging System , Production Cycle for Dredgers, Application, Capacity of dredgers, & its economical use, dredging economics.

Books & References Recommended:

1) Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.
2) Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
3) Construction Equipment Planning and Applications – Dr. Mahesh Varma.
4) Manuals, brochures, publications from construction companies, firms etc.
5) Reports of actual works executed.
6) NICMAR Publications on Construction Engineering
7) Dr. Kumar NeerajJha, ―Formwork for Concrete Structures‖, McGraw Hill Publication.

CE 5 4 7 6 3 : NUMERICAL AND SYSTEMS METHODS

CREDITS:

HOURS PER WEEK			CREDITS		MAXIMUM MARKS				
L	T	P	T	P	THEORY		PRACTICAL		TOTAL MARKS
3	-		3		CW	END SEM	SW	END SEM	100
					30	70			

COURSE OBJECTIVES:

1) Explain special types of matrices, basic matrix operationsand linear systems.
2) Define interpolation and discuss use of direct interpolation to approximate data and find derivatives.
3) Discuss Runge-Kutta 2nd order method for solving ordinary differential equations.
4) Illustrate various programming techniques
5) Discuss various rules of probability and statistics.

COURSE OUTCOMES: Students will be able to

1) Define and identify special types of matrices, perform basic matrix operations, and solve linear systems.
2) Define interpolation and use direct interpolation to approximate data and find derivatives.
3) Implement and use the Runge-Kutta 2nd order method for solving ordinary differential equations.
4) Illustrate various programming techniques
5) Apply various rules of probability and statistics.

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	1
CO2	3	2	3	2	2
CO3	3	2	3	2	2
CO4	3	3	3	3	2
CO5	3	2	3	2	3
Target	3	2.2	3	2.2	2

Legends

0 - No Correlation 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

Theory Content :

Unit – 1

Inversion of Matrix, Solutions of Simultaneous equations by elimination and Iterative methods. Solutions of ordinary differential equations by predictor corrector methods, Runge – Kutta Method.

Unit – 2

Backward, Forward and Central Difference methods, Interpolation, Extrapolation, Non-dimensionalisation.Application to partial differential equation. Summation of series, Numerical Integration and application to large elements.

Unit – 3

Introduction to optimisation, Mathematical programming techniques, Linear Programming, Integer Programming, Assignment and Transpiration Models, Dulity in L.P.

Unit – 4

Total Stage Decision Making Processes, Dynamic programming, Network Programming, Optimum project schedule, Regression Analysis.

Unit – 5

Random Variables, Discrete and Continuous Distributions, Empirical Distributions, Sampling, Point estimation, Bays Theorem, Statistical Tests of Significance.

Books & References Recommended:

1. Numerical Methods by *S.Balaguruswami, TMH Publ.*
2. Numerical Recipes in Fortran.
3. Numerical Methods in FEA by *Bathe and Wilson, PHI Publ.*
4. Operation Research by *Taha*
5. Operation Research Techniques for Management by *Benerjee, Business Book Publication House.*
6. Optimization Method in OR and system Analysis by *K.V.Mittal, Wiley Eastern Ltd.*