SEMESTER I		
NUMERICAL METHODS AND OPTIMIZATION TECHNIQUES (Theory and Practice)		
Course Code: MVJCTE101		**CIE Marks: 50**
Credits: L: T: P: 3:0:2		**SEE Marks: 50**
Hours: 40L + 20P		**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Formulate Linear programming for obtaining solution for real world problems	
2	Learn Non-linear, geometric and dynamic programming techniques for civil engineering problems.	
3	Analyze the civil engineering data and characterize with regression equations and test its efficacy.	
4	Understand the techniques of numerical methods for solving differential equations and their applications.	
5	Understand project management technique for use in real civil engineering projects	
Module-1		
Introduction to optimization techniques: Nature and characteristics of operation research. **Introduction to Linear programming:** Graphical solution, solution by simplex and revised simplex technique.		**8 Hrs**
Module-2		
Non-Linear Programming: one dimensional minimization methods, elimination methods, Fibonacci method; Dynamic programming- Introduction, Approaches, **Application and case studies:** Geometric programming methods- Introduction, Approaches, conversion of NLP as a sequence of LP.		**8 Hrs**
Module-3		
Statistical inferences: Methods of least square and regression, multiple regression. **Concept of probability:** Random Variables, Binomial, Poisson and Normal distribution, applications, Chi- squared test and Analysis of Variance.		**8 Hrs**
Module-4		
Numerical Solutions: Solution of Ordinary differential equations: Euler's method, and Rangakutta 3rd and 4th order method, Taylor's series method Solutions for **Integral Equations:** Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, and Weddle's Rule.		**8 Hrs**
Module-5		
Numerical solution of Partial Differential Equations: Introduction, Finite difference approximations to derivatives, Explicit methods-Numerical Solution of Laplace Equation, Numerical solution of one-dimensional heat equation by Bender - Schmidt's method and by Crank-Nicholson Method, Implicit methodNumerical solution of one-dimensional wave equation		**8 Hrs**
Sl. No	**Programs**	
1	Linear programming by graphical solution	
2	Statistical inferences	
3	Methods of least square	

4	Multiple regression
5	Concept of probability : Random Variables
6	Binomial distribution
7	Poisson distribution
8	Normal distribution
9	Chi- squared test
10	Analysis of Variance
11	Solution of Ordinary differential equations
12	Solutions for Integral Equations

Course Outcomes: After completing the course, the students will be able to	
CO 1	Formulate Linear programming for obtaining solution for real world problems
CO 2	Solve Non-linear, geometric and dynamic programming problems of civil engineering.
CO 3	Analyze the data and characterize with regression equations and test its efficacy.
CO 4	Solving differential equations using numerical methods
CO 5	Solve the project management problems using CPM and PERT

Text Books	
1.	S.D. Sharma, "Operations Research (Theory Methods & Applications)", 20th ed., Kedar Nath Ram Nath Publications, Meerut, UP, 2014.
2.	M K Jain, S.R.K Iyengar, R K. Jain, "Numerical methods for Scientific and Engg. Computation", 4th ed., New Age International, New Delhi, 20012.
3.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
4.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.

Reference Books	
1.	Johnson, R.A. and Bhattacharya, G.K. Statistics-Principles and Methods, 4th ed., John Wiley and Sons, New York, 2001.
2.	Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", 4th ed., TataMcGraw-Hill Publishing Company, New Delhi, 2006.

Continuous Internal Evaluation (CIE):
Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The

number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for 50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Laboratory- 50 Marks
The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE)
Total marks: 50+50-100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level

Laboratory-50 Marks
Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

SEMESTER I		
PAVEMENT MATERIALS AND CONSTRUCTION (Theory)		
Course Code: MVJCTE102		**CIE Marks: 50**
Credits: L: T: P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Explain the properties of aggregates and different test procedures and specifications and to know about the new alternative materials for road construction	
2	Explain the origin, properties, constituents and preparation of bitumen, tar, cutback bitumen and emulsions.	
3	Explain in detail about HMA, WMA, CMA and Illustrate the bituminous mix design method.	
4	Provide information on specifications of construction of different types of granular subbase, base and surface course and construction of special pavement	
5	Explain features, functioning and uses of different types of equipment's used in road construction and construction specification for different layers of road	
Module-1		
Origin and source, classification, requirements, properties and tests on road aggregates, mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; concepts of size and gradation - design gradation, significance of aggregate gradation on performance of bituminous mixes, maximum aggregate size, aggregate blending to meet specification, Fuller and Thompson's Equation, 0.45 power maximum density graph, Sampling of aggregates. Alternate and new materialscharacteristics and application in highways		**8 Hrs**
Module-2		
Bitumen and Tar: Origin, preparation, properties and chemical constitution of bituminous road binders; requirements, Grades of bitumen i.e. PG, VG. bitumen structure, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, Bituminous Emulsions and Cutbacks, Preparation, characteristics, uses and tests, Adhesion of Bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion, Modified binders.		**8 Hrs**
Module-3		
Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation Parameters and other Properties. Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short term ageing and its effect on bitumen performance, Tests to simulate ageing of bitumen viz. RTFOT and PAV. Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall's specifications, Hubbard Field method of mix design, Hveem's method of mix design; Introduction to super pave mix design procedure, HMA, WMA, CMA.		**8 Hrs**
Module-4		
Road construction equipment – different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice, productivity calculation. Problem on equipment usage charges. Investment on equipment, depreciation. Special equipment for bituminous and cement concrete pavement stabilized soil road construction.		**8 Hrs** and

Concrete Pavements: PQCFRCC- Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints	
Module-5	
Sub grade: Preparation of sub grade- construction of embankments and cuts for roads; Quality control tests. Flexible Pavements: Specifications of materials, construction method and field control check for of flexible pavement layers BM- DBM and BC Cement	

Course Outcomes: After completing the course, the students will be able to	
CO1	Able to gain knowledge about aggregates, properties and tests.
CO2	Capable of doing mix design for different layers of pavement.
CO3	Able to gain the Knowledge Bituminous Mixes and its Properties.
CO4	Assess quality of materials.
CO5	Inspect and estimate the work of equipment

Text Books	
1.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', Nem Chand and Bros, Roorkee, 2014.
2.	Partha Chakroborty and Animesh Das, 'Principles of Transportation Engineering', Prentice Hall (India), New Delhi, 2011.
3	Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice–Hall

Reference Books	
1.	Freddy L Roberts, Prithvi S Kandhaletal, "Hot Mix Asphalt Materials, mixture design and construction"-(2ndEdition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.
2.	Peurifoy.R.L., 'Construction Planning, Equipment and Methods', McGraw Hill Publishers, New York,2000.
	S.C.Sharma, 'Construction Equipment and its Management', Khanna Publishers, New Delhi, 1988.

Continuous Internal Evaluation (CIE):

Theory for 50 Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three (conduct additional quizzes and take best three). The three tests are conducted for50 marks each and the average of all the tests are calculated for 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE):

Total marks: 50+50=100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

SEMESTER I		
URBAN TRANSPORT PLANNING (Theory)		
Course Code: MVJCTE103		**CIE Marks: 50**
Credits: L: T: P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To recall the fundamental concepts, principles, and methods associated with urban transportation planning in the context of India.	
2	To summarize the techniques for designing, conducting, and managing various transportation surveys essential for data collection and planning analysis.	
3	To examine and apply key travel demand models, including mode choice and traffic assignment modeling techniques.	
4	To formulate the significance of land use modeling in transportation planning and illustrate the application of various land use models in urban contexts.	
Module-1		
Introduction to Transportation Planning, Scope and objectives of Urban Transportation Planning (UTP), Overview of various modes of transportation and their comparison, Urban transportation system planning process, Transportation demand and forecasting		**8 Hrs**
Module-2		
System approach to urban planning, Stages in transportation planning, Basic travel movements, Study area and zoning, Planning and execution of different types of transportation surveys, Inventory of transportation facilities.		**8 Hrs**
Module-3		
Trip purpose and factors influencing trip generation and attraction, Category analysis and related numerical problems, Trip distribution methods including growth factor and synthetic methods, Fratar and Furness techniques with numerical applications.		**8 Hrs**
Module-4		
Factors affecting modal split and its characteristics, Role of modal split in urban transportation planning with numerical problems, Trip assignment techniques including various methods and minimum path tree approach with numerical exercises.		**8 Hrs**
Module-5		
Interrelationship between land use and transportation systems, Characteristics of land use models, Hansen's Accessibility Model, Lowry Model, Density-Saturation Gradient Model (DSGM), Numerical examples (excluding Lowry and DSGM), Challenges in planning transportation for small and medium cities, Recent case studies in urban transportation planning.		**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the objectives, scope, and processes involved in urban transportation planning, and compare various modes of transportation.
CO2	Demonstrate the steps involved in the transportation planning process, including data collection methods and types of surveys used in transport system analysis.
CO3	Analyze factors affecting trip generation and distribution, and solve problems using category analysis, growth factor, and synthetic methods like Fratar and Furness.
CO4	Evaluate factors influencing modal split and apply trip assignment techniques to determine travel routes using numerical methods.
CO5	Assess the interrelationship between land use and transport systems by using models like Hansen's and Lowry's, and formulate planning strategies for small and medium cities using case studies.

Text Books	
1.	Khisty, C. Jotin and B. Kent Lall – Transportation Engineering: An Introduction Publisher: Prentice Hall
2.	Kadiyali, L.R. – Traffic Engineering and Transport Planning Publisher: Khanna Publishers
3	Papacostas, C.S. and Prevedouros, P.D. – Transportation Engineering and Planning Publisher: Pearson Education

Reference Books	
1.	Verma, Ashish and Tiwari, Geetam – Public Transport Planning and Management in Developing Countries Publisher: CRC Press
2.	Mannering, Fred L., Washburn, Scott S., and Kilareski, Walter P. – Principles of Highway Engineering and Traffic Analysis Publisher: Wiley India
3.	IRC: SP: 62-2017 – Guidelines on Urban Transportation Planning

SEMESTER I		
APPLIED SOIL MECHANICS AND GROUND IMPROVEMENT TECHNIQUES		
Course Code:MVJCTE104		**CIE Marks: 50**
Credits: L:T:P: 3:0:2		**SEE Marks: 50**
Hours: 40L+20P		**SEE Duration: 3Hrs.**
Course Learning Objectives:The students will be able to		
1	Explain the origin, formation, classification of soil, index properties and their determination, types of soil exploration program	
2	Provide information shear strength of soil and its measurement, elastic properties of soil	
3	Explain various ground improvement techniques and the types of compactions and its effect on soil properties	
4	Explain the types of drains and various stabilization techniques	
5	Inform about the types of reinforcement and design principles, grouting techniques	
Module-1		
Introduction to Soil Mechanics and Site Investigation: Soil Mechanics applications to Highway Engineering. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, numerical on these. **Site Investigation:** Introduction, Planning exploration programmes, Types of Exploration, Location and depth of Borings, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.		**8Hrs**
Module-2		
Shear Strength Of Soil: Introduction, Importance, Measurements, shear strength of clay and Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus		**8Hrs**
Module-3		
Ground Improvement: Definition, Objectives of ground improvement, Classification of ground Improvement techniques Soil Compaction- Effect of grain size distribution on compaction for various soil types like lateritic soil, coarse-grained soil and micaceous soil, Stability of slopes. The Effects of compaction on engineering behaviour like compressibility, swelling and shrinkage, permeability, relative density, liquefaction potential. Field compaction – static, dynamic, impact and vibratory type. Shallow and deep compaction, Dynamic Compaction, Vibro-floatation		**8Hrs**
Module-4		
Hydraulic Modification and Chemical Modification Hydraulic modification – Definition, gravity drain, lowering of water table, multistage well point, vacuum		**8Hrs**

dewatering. Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading. Chemical modification – Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics, Stabilization using Fly ash. Lime stabilization – suitability, process, criteria for lime stabilization. Other chemicals like chlorides, hydroxides, lignin and hydrofluoric acid. Bitumen, tar or asphalt in stabilization.	
Module-5	
Soil Reinforcement: Earth reinforcement – Principles and mechanism of reinforced earth- reinforced soil retaining structures, Synthetic and natural fibre-based Geo textiles and their applications - Filtration, drainage, separation, and erosion control. Design Principles of steep reinforced soil slopes – pavements – Embankments on soft soils, introduction to soil nailing concepts, Case studies.	**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Able to gain knowledge of soil, origin, and exploration.
CO2	Able to understand shear strength of soil and its measurement, elastic properties of soil
CO3	Analyse the field problems related to problematic soils and solve the problems using the ground Improvement techniques.
CO4	Application of physical and chemical ground improvement techniques using thermal modification, like grouting, shotcreting and guniting technology.
CO5	About the types of reinforcement and design principles, grouting techniques

Text Books	
1.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', NemChand and Bros, Roorkee, 2014.
2.	Partha Chakroborty and Animesh Das, 'Principles of Transportation Engineering', Prentice Hall (India), New Delhi, 2011.
3.	Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice– Hall

ContinuousInternalEvaluation(CIE):
Theoryfor50Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments.Aminimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10marks.Faculty may adopt innovative methods for conducting quizzes effectively.The number of quizzes may be morethan three (conduct additional quizzes and take best three).The three tests are conducted for 50 marks each and the average of all the tests are calculatedfor 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Laboratory-50Marks
The laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of the marks over number of weeks is considered for 30 marks. At the end of the semester a test is conducted for 10 marks. The students are encouraged to implement additional innovative experiments in the lab and are awarded 10 marks. Total marks for the laboratory is 50.

Semester End Examination (SEE)
Total marks: 50+50-100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level

Laboratory-50 Marks
Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

SEMESTER I		
ADVANCED TRAFFIC ENGINEERING		
Course Code:MVJCTE105		**CIE Marks: 50**
Credits: L:T:P: 3:0:2		**SEE Marks: 50**
Hours: 40L+20P		**SEE Duration: 3Hrs.**
Course Learning Objectives:The students will be able to		
1	Provide an insight on traffic and its components, factors affecting road traffic and the design of intersection.	
2	Explain sampling of data, analysis and interpretation of data in conducting various surveys.	
3	Explain traffic movements, types of intersections, islands, crossings and their design.	
4	Illustrate the design of signals and explain the redesigning of existing signals.	
5	Provide an insight on traffic regulations, pollution caused by traffic and the method of controlling pollution	
Module-1		
Introduction to Traffic Engineering: Objectives and scope of traffic engineering, Components of road traffic - the vehicle, driver and road, Road user characteristics; human and vehicle characteristics, factors affecting road traffic; methods of measurement. Concepts of passenger car units for mixed traffic flow. Numerical Examples on above.		**8Hrs**
Module-2		
Traffic Engineering Studies and Analysis: Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, methods of traffic study, equipment, data collection, analysis and interpretation (including case studies) of (i) Spot speed (ii) Speed and delay studies (iii) Volume studies (iv) Origin – Destination survey (v) Parking studies vi) Accident studies.(As per relevant IRC formats).		**8Hrs**
Module-3		
Design of Traffic Engineering Facilities: Control of Traffic Movements through Time Sharing and Space Sharing Concepts; Channelizing Islands, T, Y, Skewed, Staggered, Roundabout, Mini-round about and other forms of at-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections.		8Hrs
Module-4		
Traffic Control Devices: Traffic signs, markings, islands and signals. Different methods of signal design; redesign of existing signal including case studies, VMS, Road Lighting. Analysis of conflict points for all types of junctions and condition.		**8Hrs**
Module-5		
Traffic safety and management: Road accidents, causes, effects and prevention, promotion and integration of public transport, promotion of non-motorized transport, area traffic management system, traffic system management (TSM), travel demand management (TDM), Congestion and parking pricing.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Able to acquire and apply knowledge of traffic, its components, factors affecting road traffic intersection design
CO2	Able to apply the knowledge of sampling data in conducting various surveys and analysis
CO3	Capable of understanding traffic movements and designing islands, intersections and road lightings.
CO4	Capable of designing signals, redesigning the existing signals.
CO5	Able to remember traffic regulations, impact of noise pollution, air pollution and the method of controlling them.

TextBooks	
1.	Drew D R "traffic flow theory and control", McGraw Hill Book Co.
2.	Papacostas, C A. "Fundamentals of Transportation Engineering", Prentice-hall of India Private Limited, NEW Delhi.2000
3.	Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2013
4.	Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management

ContinuousInternalEvaluation(CIE):
Theory for 50Marks

CIE is executed by way of quizzes (Q), tests (T) and assignments.Aminimum of three quizzes are conducted along with tests. Test portion is evaluated for 50 marks and quiz is evaluated for 10marks.Faculty may adopt innovative methods for conducting quizzes effectively.The number of quizzes may be morethan three (conduct additional quizzes and take best three).The three tests are conducted for 50 marks each and the average of all the tests are calculatedfor 50. The marks for the assignments are 20 (2 assignments for 10 marks each). The marks obtained in test, quiz and assignment are added to get marks out of 100 and report CIE for 50 marks.

Semester End Examination (SEE)
Total marks: 50+50-100

SEE for 50 marks is executed by means of an examination. The Question paper consists of five questions one from each unit for 20 marks adding up to 100 marks. Each main question may have a maximum of three subdivisions. Each unit will have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level

Laboratory-50 Marks
Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

SEMESTER I	
HIGHWAY MATERIALS TESTING LAB (Practice)	
Course Code: MVJCTEL106	**CIE Marks: 50**
Credits: L: T: P: 1:0:1	**SEE Marks: 50**
Hours: 30	**SEE Duration: 3 Hrs.**

Course Learning Objectives: The students will be able to	
1	Explain the properties of aggregates and different test procedure of conduction and specifications
2	Explain procedures of conducting tests on neat bitumen and modified bitumen.
3	Explain Rothfutch method of marshal mix design

LABORATORY EXPERIMENTS

1. Determination of Crushing strength of aggregates by Compression test
2. Determination of Toughness of an aggregate by Impact test.
3. Determination of Hardness of an aggregate by Abrasion test.
4. Shape tests on aggregates.
5. Determination of Specific Gravity and Water absorption of Coarse aggregate by Wire basket method.
6. Test on Stripping value of aggregates.
7. Determination of penetration value of bitumen.
8. Determination of softening point of bitumen using ring ball apparatus.
9. Test on viscosity of bitumen.
10. Test on ductility value of bitumen.
11. Determination of flash and fire point of bitumen
12. Specific gravity test on bitumen.
13. Marshal stability test on bitumen mix.

Course Outcomes: After completing the course, the students will be able to	
CO1	To understand and evaluate the physical properties of aggregates.
CO2	To understand and test the key properties of bitumen.
CO3	To evaluate the stability and performance of bitumen mixes.

Reference Books	
1.	IS 9377: 1979 - Test for Aggregate Hardness by Los Angeles Abrasion
2.	IS 2386 (Part 1): 1963 - Methods of Test for Aggregates for Concrete: Part 1: Particle Size and Shape
3.	IS 2386 (Part 3): 1963 - Methods of Test for Aggregates for Concrete: Part 3: Specific Gravity, Density, Voids, Absorption, and Bulking
4.	IS 1203: 1978 - Determination of Penetration of Bitumen
5.	IS 1205: 1978 - Determination of Softening Point of Bitumen (Ring and Ball Method)

6.	IS 1206 (Part 1): 1978 - Determination of Viscosity of Bitumen (Rotary Viscometer Method)
7.	IS 1208: 1978 - Determination of Ductility of Bitumen

SEMESTER II		
PAVEMENT GEO-TECHNIQUES **(Theory & Practice)**		
Course Code: MVJCTE201		**CIE Marks: 50**
Credits: L: T: P: 3:0:1		**SEE Marks: 50**
Hours: 40L + 12P		**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the origin, classification, and engineering properties of soils and subgrade materials essential for pavement construction and evaluation.	
2	Analyze the properties of road aggregates and the cyclic behavior of soils and aggregates under traffic loads and environmental forces to assess material suitability	
3	Apply pavement design principles for flexible and rigid pavements using standard methods such as CBR and Westergard's stress analysis, including stress computations	
4	Design highway embankments and reinforced earth structures, considering construction methods, stability requirements, and stage construction techniques	
5	Evaluate pavement behaviour and performance by applying fundamental stress-strain concepts and appropriate analytical and design methodologies.	
Module-1		
Origin, classification, and properties of soils. Subgrade Soil: Classification, desirable properties, determination of soil strength characteristics		**8 Hrs**
Module-2		
Road aggregates: classification, properties of aggregates, design of aggregate gradation; Cyclic response of soils, resilient and plastic behaviour of soils and aggregates, Effects of traffic loads, natural forces, and material quality.		**8 Hrs**
Module-3		
Pavement design principles: Introduction to Flexible and Rigid pavements, Design of Flexible Pavement by CBR Method (CSA), Design of Rigid pavements by Westergard's Stress Analysis-Wheel Load Stresses-Temperature stresses. (Numericals)		**8 Hrs**
Module-4		
Highway embankments; Design and construction of embankments; Stage construction; Introduction to reinforced earth design and construction..		**8 Hrs**
Module-5		
Pavement analysis: Methods for analyzing pavement behavior and performance. Basic concepts of stress and strains, analysis of pavement responses, and various design methodologies.		**8 Hrs**

Sl. No	Experiments
1	Tests on Soil: Determination of specific gravity, particle size distribution, Moisture content –dry density relationship by standard proctor compaction test, compressive strength of a cylindrical cohesive soil specimen in unconfined compression, field density of soil by core-cutter method and sand replacement method
2	Tests on Road Aggregates: Aggregate Impact Test Los Angeles Abrasion Test Aggregate Crushing Value Test Specific Gravity Test and Water Absorption Test Shape Tests Flakiness Index Elongation Index Angularity Number
3	Tests on Sub grade Soil: Modified Compaction Test, California Bearing Ratio Test

Course Outcomes: After completing the course, the students will be able to	
CO1	Classify soils and subgrade materials based on their origin, properties, and strength characteristics relevant to pavement applications.
CO2	Evaluate the properties of road aggregates and analyze the effects of traffic loading and environmental factors on the resilient and plastic behavior of soils and aggregates.
CO3	Design flexible and rigid pavements using methods such as the CBR approach and Westergard's stress analysis, incorporating wheel load and temperature stresses
CO4	Develop the design and construction methods for highway embankments and reinforced earth structures, considering stage construction techniques.
CO5	Analyze pavement responses under different loading conditions using stress-strain principles and apply appropriate pavement analysis and design methodologies

Text Books	
1.	Soil Mechanics and Foundations, Muniram Budhu(2007), John Wiley & Sons, Inc
2.	Chakraborty P. and Das, A. Principles of Transportation Engg., PHI Publication, 1st Edition 2005
3	S. K. Khanna, C. E. G. Justo and A. Veeraragavan, "Highway Engineering", Revised 10th Edition, Nem Chand and Bros, Roorkee, 2014

Reference Books	
1.	Rao, G.V. Principles of Transportation and Highway Engineering, Tata Mc. Graw Hill, 1st Ed. 1995.
2.	S. P. Bindra, "A Course in Highway Engineering", Dhanpat Rai Publications, 5th Revised Edition, 2013.
3.	Foundations of Theoretical Soil Mechanics, Harr, M.E (1966) McGraw Hill

SEMESTER II		
PAVEMENT ANALYSIS AND DESIGN **(Theory)**		
Course Code: MVJCTE202		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Identify and categorize the factors affecting design and performance of pavements.	
2	Explain the basic methods and concepts used to analyse flexible and rigid pavements.	
3	Explain different design methods for flexible and rigid pavement design.	
4	Explain Structural and functional requirements of flexible and rigid pavements.	
Module-1		
Introduction: Factors Affecting Pavement Design, Variables Considered in Pavement Design, Types of Pavements, and Functions of Individual Layers, Classification of Axle Types, Tire Pressure, Contact Pressure, EAL and ESWL Concept, Lane Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads.		**8Hrs**
Module-2		
Stresses And Deflections In Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister's two-layer theory, three layer and multilayer theories, Problems on above.		**8Hrs**
Module-3		
Flexible Pavement: Design Methods Principle, design steps, advantages and applications of different pavement design methods – Group Index, CBR, McLeod, Kansas Triaxial test, IRC, AASHTO and Asphalt Institute methods		**8Hrs**
Module-4		
Stresses In Rigid Pavements: Factors affecting design and performance of pavements. Types of stresses and causes, factors influencing the stresses, general considerations in rigid pavement analysis, EWL, wheel load stresses, warping stresses, frictional stresses, combined stresses. Problems on above.		**8Hrs**
Module-5		
Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacing, design of CC pavement for roads and runways, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements. Design of low volume CC roads. Problems on above		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate a comprehensive understanding of pavement types, their structural layers, influencing factors in pavement design, and the impact of vehicle characteristics such as axle loads, tire pressure, and traffic loading parameters
CO2	Explore stress distribution and deflection patterns in flexible pavements using theoretical models like Burmister's multi-layer system for various loading conditions.
CO3	Examine multiple flexible pavement design approaches, highlighting their principles, procedures, and suitability under different environmental and traffic scenarios.
CO4	Interpret the behavior of rigid pavements under different stress conditions, including wheel load stress, temperature-induced warping, and frictional effects, considering performance related variables.
CO5	Develop structural pavement designs for rigid concrete pavements, including detailing of joints and reinforcements, considering guidelines for highways, runways, and low-volume roads.

Text Books	
1.	**Yoder, E.J., and Witczak, M.W.** *Principles of Pavement Design*, 2nd Edition, John Wiley & Sons, 1975.
2.	**Khanna, S.K., and Justo, C.E.G.** *Highway Engineering*, 10th Edition, Nem Chand & Bros., 2014.
3.	**Vazirani, V.N., and Chandola, S.P.** *Transportation Engineering Vol. II: Highway Engineering*, Khanna Publishers, 2006.
4.	**Sharma, S.K.** *Principles, Practice and Design of Highway Engineering*, S. Chand & Company Ltd., 2013.

Reference Books	
1.	**Huang, Y.H.** *Pavement Analysis and Design*, 2nd Edition, Pearson Education, 2004.
2.	**Indian** Roads Congress (IRC):IRC: 37-2018 – Guidelines for the Design of Flexible Pavements and IRC: 58-2015 – Guidelines for the Design of Plain Jointed Rigid Pavements for Highways

SEMESTER II		
TRANSPORTATION ECONOMICS AND EVALUATION **(Theory)**		
Course Code: MVJCTE203		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Explain the basic terminology of economics and its application in transportation	
2	Define the concept and components involved in economic evaluation	
3	Explain the various methods of economic analysis and ranking of alternatives	
4	Illustrate the method of economic evaluation for transportation projects	
Module-1		
Principles of Economics: Supply and demand models, Consumer's surplus and social surplus criteria, and framework for social accounting: accounting rate of interest, social opportunity cost, rate of interest, social time preference rate of interest, accounting prices of goods and services, measuring input costs, applications on social accounting.		**8Hrs**
Module-2		
Transport Costs and Benefits: Fixed and variable cost, cost of improvement, maintenance cost, cost estimating methods, accounting for inflation, external costs, Direct benefits: reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost.		**8Hrs**
Module-3		
Project Evaluation: Framework of evaluation, transport planning evaluation at urban and regional levels, other evaluation procedures, environmental evaluation, safety evaluation, project financing.		**8Hrs**
Module-4		
Economic Analysis: Generation and screening of project alternatives, different methods of economic analysis: annual cost and benefit ratio methods, discounted cash flow methods, shadow pricing techniques, determination of IRR, EUAC, PWOC, EUANR and NPV, examples of economic analysis, application economic theory in traffic assignment problem.		**8Hrs**
Module-5		
Environmental Impact Assessment : Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety and Capacity Impacts – Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical case studies on environmental assessment.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand and explain the principles of economics relevant to transportation systems.
CO2	Analyze transport costs and benefits including both direct and indirect effects.
CO3	Evaluate transportation projects using appropriate economic analysis frameworks.
CO4	Apply various economic evaluation methods such as NPV, IRR, and BCR for transportation alternatives.
CO5	Assess environmental impacts and integrate EIA techniques into transportation project evaluation.

Text Books	
1.	**Button, K.J.,** Transport Economics, Edward Elgar Publishing, 2010.
2.	**Nash, C.A.,** Microeconomic Techniques for Transport Planning and Evaluation, Oxford University Press, 1975.
3.	**Winfrey, R.**, Economic Analysis for Highways, International Textbook Company, 1969.
4.	**Grubb, M., Köhler, J., Anderson, D.,** The Economics of Climate Change and Transport, Routledge, 2009.

Reference Books	
1.	**Sinha, K.C., and Labi, S.,** Transportation Decision Making – Principles of Project Evaluation and Programming, John Wiley & Sons, 2007.
2.	**Berechman, J.,** Transport Investment and Economic Development, Routledge, 2001.

SEMESTER II		
RAILWAYS AND AIRWAYS **(Theory)**		
Course Code: MVJCTE204		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Provides the basic knowledge about the railways, components	
2	Provides the basic knowledge about the geometric design of points and crossings.	
3	Provides the basic knowledge about airports, runways, taxiways and its design.	
4	Provide basic knowledge about heliports, characteristics, design of heliports.	
Module-1		
Permanent way and its requirements, Gauges and types, Typical cross sections, Coning of wheels and Tilting of rails, Components- Types, sections length- Defects- wear- creep- welding- joints. Track fitting and fastener, Calculation of quantity of materials, Tractive resistances and hauling capacity- Numerical examples		**8Hrs**
Module-2		
Geometric Design: Necessity, Safe speed on curves. Cant, cant deficiency, negative cant, safe speed, Transition curve, gradient, grade compensation Points and Crossings: Components of a turnout, design of turnouts, types of switches, crossings, track junctions. Stations and yards. Signalling: Objects and types of signals. Fouling mark, buffer stop, level crossing, track defects- Numerical examples.		**8Hrs**
Module-3		
Railway sections and yards - Purpose, site selection, facilities, requirements, classification, platforms, building areas, types of yards, foot over bridges, subways, cranes, weigh bridge, loading gauge, end loading ramps, locomotive sheds, ash-pits, water columns, turntable, triangles, buffer stop, scotch block. Train accidents, derailments and its causes		**8Hrs**
Module-4		
Airport Introduction: Layout of an airport with component parts and functions, Site selection for airport, Aircraft characteristics affecting the design and planning of airport, Airport classification, Runway orientation using wind rose- Numerical examples. Runway: Basic runway length-Corrections and examples**.**		**8Hrs**
Module-5		
Taxiway: Factors affecting the layout - geometrics of taxiway-Design of exit taxiway - Numerical examples. Visual aids- Airport marking – lighting-Instrumental Landing System. Heliports and their Design: Introduction, Helicopter characteristics, planning of heliports, Visual aids of heliports.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate a comprehensive understanding of railway components, track fittings, and material requirements, along with the calculation of tractive resistance and hauling capacity.
CO2	Analyze the geometric design of railway tracks, including curves, cant, gradient, and design of points, crossings, and signaling systems for safe train operations.
CO3	Evaluate the design and layout of railway stations, yards, and related facilities, focusing on train accidents, derailments, and site-specific requirements.
CO4	Understand the layout and design factors of airports, considering aircraft characteristics, airport classification, and runway orientation using wind rose diagrams.
CO5	Design taxiways, layout considerations for heliports, and visual aids required for effective airport operation, along with understanding the impact of geometrical factors on taxiway design.

Text Books	
1.	**S.C. Saxena and S. S. Bhatia** Railway Engineering, 2nd Edition, Dhanpat Rai & Sons, New Delhi, 2010
2.	**M.M. Agarwal** Indian Railway Track, Jaico Publications, Bombay, 2008.
3.	**Khanna, S.K., Arora, M.** Airport Planning and Design, Nem Chand & Bros, Roorkee, 2013.
4.	**Raghuwanshi, B.S.** Railway Engineering, 3rd Edition, Dhanpat Rai & Sons, 2016.

Reference Books	
1.	**John W. Hurd** Design of Airports, 7th Edition, McGraw-Hill Education, 2017.
2.	**Chien, S., Ding, Y., and Wei, C.** Airport Planning and Management, 8th Edition, McGraw-Hill Education, 2016.

SEMESTER II		
ROAD SAFETY AND MANAGEMENT (Theory)		
Course Code: MVJCTE2051		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Explain different parameters responsible for providing road safety in the construction of new roads	
2	Describe road reconstruction principle and improvement of road considering the different components of road and intersections	
3	Discuss road safety and maintenance measures for road in operation considering pedestrian, cyclists and road furniture	
4	Evaluate road safety audit principle and procedure, various traffic management techniques and their effectiveness	
Module-1		
Road accidents, Causes, Scientific Investigations and Data Collection: Accident Analysis considering different scenarios, Analysis of Individual accidents to arrive at Real Causes, Statistical Methods of Analysis of Accident Data.		**8Hrs**
Module-2		
Ensuring Traffic Safety in Designing New Roads: Ways of Ensuring Traffic Safety in Road Design considering the Features of Vehicle Fleet, Psychological Features of Drivers, Natural and Meteorological Conditions, Structure of Traffic Streams, Orientation of a Driver on the Direction of a Road beyond the Limits of Actual Visibility and Roadway Cross Section and Objects on the Right- of-Way		**8Hrs**
Module-3		
Ensuring Traffic Safety in Road Reconstruction: Road Reconstruction and Traffic Safety, Reconstruction Principles, Plotting of Speed Diagram for Working out Reconstruction Projects, Use of Accident Data in Planning Reconstruction of Roads.		**8Hrs**
Module-4		
Ensuring Traffic Safety in Road Operation: Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines and Guide Posts, Guardrails and Barriers and Road Lighting.		**8Hrs**
Module-5		
Road Safety Audit and Traffic Management Techniques: Principles- Procedures and Practice, Code of Good Practice and Checklists. Road safety issues and engineering, education, enforcement measures for improving road safety. Local area management. Low cost measures, area traffic control.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Recognize the factors affecting the construction of new roads
CO2	Illustrate the factors affecting the reconstruction of existing roads
CO3	Summarize the factors affecting the operation condition of road
CO4	Remember and illustrate the process of road safety audit and the measures of improving road safety
CO5	Recognize the factors affecting the construction of new roads

Text Books	
1.	Babkov, V.F. ‘Road conditions and Traffic Safety', MIR publications, Moscow - 1975.
2.	K.W. Ogden, `Safer Roads – A Guide to Road Safety Engg.’ Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996.
3.	Kadiyali, L.R., `Traffic Engineering and Transport Planning', Khanna Publications, New Delhi, 2009.
4.	Jotin Kishty and B. Kent Lall, ‘Transportation Engineering-An Introduction’, Third Edition, Prentice Hall of India Private Limited, New Delhi, 2006

Reference Books	
1.	Relevant IRC Publications.
2.	MORTH “Manual for Road Safety in Road Design”- Indian Roads Congress

SEMESTER II		
INTELLIGENT TRANSPORTATION SYSTEMS **(Theory)**		
Course Code: MVJCTE2052		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the basic concepts, elements, and technologies involved in Intelligent Transportation Systems (ITS).	
2	Learn and apply data collection methods used in ITS such as AVL, AVI, and GIS.	
3	Analyze ITS applications in public transportation, commercial vehicle operations, safety, and security.	
4	Explore travel demand management strategies, electronic tolling, and ITS deployments in global and developing contexts.	
Module-1		
Basic elements of intelligent transportation systems (ITS), focusing on technological, systems and institutional aspects. Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection		**8Hrs**
Module-2		
Advanced traveller information systems; transportation network operations; commercial vehicle operations and intermodal freight		**8Hrs**
Module-3		
Public transportation applications, ITS and regional strategic transportation planning, including regional architectures.		**8Hrs**
Module-4		
ITS and changing transportation institutions, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility		**8Hrs**
Module-5		
Travel demand management, electronic toll collection, and ITS and road-pricing. Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the basic elements, technologies, and benefits of Intelligent Transportation Systems.
CO2	Apply ITS data collection techniques and interpret the information for transportation planning.
CO3	Design ITS applications for public transportation systems and regional transportation planning.
CO4	Analyze the institutional, safety, and security issues associated with ITS deployment.
CO5	Evaluate travel demand management, electronic toll collection systems, and global ITS initiatives.

Text Books	
1.	Sussman, J.M., Perspective on Intelligent Transportation Systems (ITS), Springer, 2005.
2.	McQueen, B., and McQueen, D., Intelligent Transportation Systems Architectures, Artech House, 1999.
3.	Papageorgiou, M., Applications of Automatic Control Concepts to Traffic Flow Modeling and Control, Springer, 1983.
4.	Chien, S., Ding, Y., and Wei, C., Dynamic Bus Arrival Time Prediction with Artificial Neural Networks, Journal of Transportation Engineering, 2002.

Reference Books	
1.	Robertson, D.I., Research onRobertson, D.I., Research on Road Traffic, HMSO London, 1968. Road Traffic, HMSO London, 1968.
2.	Levine, S.I., and McCasland, W.R., Advanced Traffic Control Systems, Transportation Research Board, 1997.

SEMESTER II		
PAVEMENT EVALUATION AND MANAGEMENT **(Theory)**		
Course Code: MVJCTE2053		**CIE Marks: 50**
Credits: L: T: P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the structural and functional requirements of pavements, types of pavement distresses, causes of failures, and appropriate remedial measures.	
2	Apply various methods for functional evaluation of pavements, including assessment of surface condition, skid resistance, roughness, and performance indices like PCI and PSI.	
3	Analyze the structural condition of pavements using non-destructive and destructive testing methods such as FWD, Benkelman Beam, plate load tests, and material specimen evaluations.	
4	Develop comprehensive pavement management strategies, including planning, investment decision-making, and formulating design objectives and constraints	
5	Evaluate and compare alternative pavement design strategies using structural response models, prediction techniques (AASHTO, CRRI, HDM models), and economic analysis to select optimal solutions.	
Module-1		
Pavement Evaluation : Introduction- Structural and functional requirements of flexible and rigid pavement; pavement distress; different types of failures, causes and remedial measures		**8 Hrs**
Module-2		
Functional evaluation of pavements: Evaluation of Surface Condition: Methods of evaluating pavement surface condition, PCI & PSI measurement of skid resistance and unevenness by various methods, their applications.		**8 Hrs**
Module-3		
Structural evaluation of pavements: Evaluation by non- destructive tests such as FWD, Benkelman Beam rebound deflection using BBD for flexible overlay design, Plate load test, wave propagation and other methods of load tests, evaluation by destructive test methods, and specimen testing.		**8 Hrs**
Module-4		
Pavement management: Historical Background -General nature and applicability of systems methodology, basic components of Pavement Management System, planning pavement investments. Design Strategies - Framework for pavement design – design objectives and constraints.		**8 Hrs**
Module-5		
Basic structural response models: Characterization of physical design inputs – generating alternative pavement design – economic evaluation of alternative design – analysis of alternative design strategies – selection of optimal design strategy. Techniques for developing prediction models – AASHTO, CRRI and HDM models.		**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand importance of evaluation and strengthening of pavements
CO2	Understand the methods of pavement surface evaluation
CO3	Gain knowledge of various methods of structural and functional evaluation of rigid and flexible pavements
CO4	Develop a framework for efficient pavement design
CO5	Formulate the development and application of models for pavement management

Text Books	
1.	**Yoder, E.J., and Witzack,** 'Principles of Pavement Design', 2 nd Edition, John Wiley and Sons (1991)
2.	**Ralph Haas, W.Ronald Hudson and John Zaniewski,** Modern Pavement Management, Kreigar Publishing Company, New York(1994)
3	**M.Y.Stalin, Chapman** and Hall Pavement Management for Airports, Roads and Parking Lots, New York

Reference Books	
1.	Michael Sargious, Pavements and surfacings for Highways and Airports, Applied Science Publishers Limited, London, 1975
2.	Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co.1978.

SEMESTER II		
THEORY OF TRAFFIC FLOW **(Theory)**		
Course Code: MVJCTE2054		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand traffic stream parameters and their inter-relationships.	
2	Analyze and model traffic flow using macroscopic and microscopic approaches.	
3	Apply queuing theory, shockwave theory, and capacity concepts to practical traffic situations.	
4	Utilize traffic flow data collection techniques and traffic simulation models for analysis.	
Module-1		
Traffic Flow Fundamentals and Characteristics: Scope and significance of traffic flow theory. Traffic stream parameters: speed, flow, density, and their relationships. Fundamental diagrams: speed-flow, speed-density, flow-density. Introduction to macroscopic and microscopic traffic flow models. Human factors affecting traffic flow: driver behavior and perception-reaction time.		**8Hrs**
Module-2		
Traffic Flow Models: Macroscopic models: Lighthill-Whitham-Richards (LWR) model, Payne's model. Microscopic models: Car-following models (e.g., General Motors model), lane-changing models. Mesoscopic models combining macroscopic and microscopic characteristics. Stability analysis of traffic flow, concept of shockwaves, and capacity drop phenomena.		**8Hrs**
Module-3		
Traffic Flow Theories and Applications: Application of queuing theory in traffic flow, types of queues, and their characteristics. Shockwave theory: formation, propagation, and dissipation. Traffic simulation models: types and application. Capacity analysis of roadways under different conditions.		**8Hrs**
Module-4		
Traffic Flow Measurement and Data Analysis: Traffic data collection techniques: manual and automated (detectors, sensors). Data analysis: statistical methods, regression models, calibration of traffic flow models. Estimation of traffic stream parameters (speed, flow, density). Introduction to traffic analysis software tools.		**8Hrs**
Module-5		
Advanced Topics in Traffic Flow: Role of Intelligent Transportation Systems (ITS) in traffic flow. Urban network traffic flow: challenges and strategies. Multimodal traffic flow: interaction of various modes (cars, buses, bicycles, pedestrians). Case studies on real-world traffic flow scenarios and problem-solving approaches.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain traffic stream parameters and fundamental relationships in traffic flow.
CO2	Develop and analyze macroscopic, microscopic, and mesoscopic traffic flow models.
CO3	Apply queuing theory and shockwave analysis to real-world traffic problems.
CO4	Measure and statistically analyze traffic flow data using modern tools.
CO5	Evaluate the impact of advanced technologies and multimodal traffic on traffic flow systems.

Text Books	
1.	May, A.D., *Traffic Flow Fundamentals*, Prentice Hall, 1990.
2.	Drew, D.R., *Traffic Flow Theory and Control*, McGraw-Hill, 1968.
3.	Papageorgiou, M., *Applications of Automatic Control Concepts to Traffic Flow Modeling and Control*, Springer, 1983.
4.	Cassidy, M.J., *Traffic Flow Fundamentals*, MIT Open Courseware Notes, 2010.

Reference Books	
1.	Gartner, N.H., Messer, C.J., and Rathi, A.K., *Traffic Flow Theory: A State-of-the-Art Report*, Transportation Research Board, 2001
2.	TRB Special Report 165, *Traffic Flow Theory*, Transportation Research Board, National Research Council, 1975.

SEMESTER II		
RURAL ROADS (Theory)		
Course Code: MVJCTE2061		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Explain the concept and objective of providing low-cost roads in developing country like India.	
2	Understand problems involved in the design of rural roads, preparation of rural road development plans and economic viability.	
3	Explain different types of surveys required for road alignment and road geometry with appropriate specifications.	
4	Introduce different materials used for construction and different types of construction procedures and equipment required for construction.	
Module-1		
Introduction: Concept Objective, Scope and coverage of low cost and rural roads. Explain significance of low-cost roads for developing countries, with special reference to India		**8Hrs**
Module-2		
Rural Road Planning and Investment: Problems associated with planning of low volume rural roads in India. Rural road network planning- principles and methods. Socio-economic aspects in planning, preparation of rural road master plans and their evaluation: stage construction, planning and utilization of successive investments.		**8Hrs**
Module-3		
Location Surveys and Geometrics Design: Location surveys, geometric design standards for rural roads, special considerations for rural roads in hilly area.		**8Hrs**
Module-4		
Materials: Stabilized soils, Design of soil-lime, soil-cement, soil-bitumen and soil-lime-fly ash mixes, Use of soft aggregates. Construction, Operation and Plants: Surveying and setting, excavation, hauling, Shaping and compaction, Stabilized soils-spreading, mixing and compaction. Appropriate technology, tools, plants and equipment for construction as per IRC practices.		**8Hrs**
Module-5		
Road Drainage and Maintenance: Drainage of road surface, pavement layers and cross drainage works. Various low cost drainage alternatives. Short term routine maintenance, long term maintenance, organizational and financial aspects of maintenance works.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Able to remember significance of low cost roads.
CO2	Capable of analysing the problem associated with planning of low volume roads, preparing master plan of rural road network.
CO3	conduct surveys for rural road alignment and remembering specifications of various geometric features of road.
CO4	select and analyse different materials and equipment's required for rural road Construction.
CO5	Able design various drainage structures and cross drainage works giving due importance to maintenance activities.

TextBooks	
1.	**Khanna, S.K., Justo, C.E.G., and Veeraragavan, A.,** `Highway Engineering', Nem Chand and Bros, Roorkee
2.	**IRC SP 20:** 'Rural Roads Manual, Indian Roads Congress', New Delhi, 2002.
3.	KRRDA Handbook for rural roads.
4.	HMSO, "Soil Mechanics for Road Engineers", Her Majesty's Stationary Office, London

ReferenceBooks	
1.	Relevant IRC Codes & Publications
2.	International Road Maintenance Hand Book –Maintenance of Paved Roads France

SEMESTER II		
CONSTRUCTION PROJECT MANAGEMENT **(Theory)**		
Course Code: MVJCTE2062		**CIE Marks: 50**
Credits: L: T: P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	Understand the fundamental principles of management, construction project organization, planning processes, and scheduling techniques like CPM.	
2	Apply construction resource management strategies, including labor management, equipment productivity estimation, and equipment cost analysis	
3	Analyze material management practices, construction quality systems (QA/QC), safety measures (HSE), and human values related to construction activities.	
4	Evaluate engineering economic principles such as time value of money, interest rates, and cost analysis for effective decision-making in construction projects.	
5	Develop skills to compare and select alternatives based on economic evaluation techniques like present worth, annual cost, rate of return, and break-even analysis.	
Module-1		
Management: Characteristics of management, functions of management, importance and purpose of planning process, types of plans Introduction to construction management, project organization, management functions, management style		**8 Hrs**
Module-2		
Construction Planning and Scheduling: Introduction, types of project plans, work breakdown structure, Grant Chart, preparation of network diagram- event and activity based and its critical path-critical path method, concept of activity on arrow and activity on node.		**8 Hrs**
Module-3		
Resource Management: Basic concepts of resource management, class of labour, Wages & statutory requirement, Labour Production rate or Productivity, Factors affecting labour output or productivity. **Construction Equipments:** classification of construction equipment, estimation of productivity for: excavator, dozer, compactors, graders and dumpers. Estimation of ownership cost, operational and maintenance cost of construction equipments. Selection of construction equipment and basic concept on equipment maintenance		**8 Hrs**
Module-4		
Materials: material management functions, inventory management **Construction Quality, safety and Human Values:** Construction quality process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management **HSE:** Introduction to concepts of HSE as applicable to Construction. Importance of safety in		**8 Hrs**

construction , Safety measures to be taken during Excavation , Explosives , drilling and blasting , hot bituminous works , scaffolds / platforms / ladder , form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurances.	
Module-5	
Introduction to engineering economy: Principles of engineering economics, concept on Micro and macro analysis, problem solving and decision making. **Interest and time value of money**: concept of simple and compound interest, interest formula for: single payment, equal payment and uniform gradient series. Nominal and effective interest rates, deferred annuities, capitalized cost. **Comparison of alternatives**: Present worth, annual equivalent , capitalized and rate of return methods , Minimum Cost analysis and break even analysis	**8 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate knowledge of management functions and project organization structures for effective construction project management.
CO2	Plan and schedule construction activities using work breakdown structures, network diagrams, and critical path methods.
CO3	Manage construction resources efficiently by analyzing labor productivity, estimating equipment costs, and selecting suitable construction equipment.
CO4	Implement construction material management practices, quality assurance processes, and safety standards (HSE) for sustainable project execution.
CO5	Solve construction engineering problems using principles of engineering economics, including cost comparison methods and decision-making strategies

Text Books	
1.	**P C Tripathi and P N Reddy,** "Principles of Management", Tata McGraw-Hill Education
2.	**Chitkara, K.K,** "Construction Project Management: Planning Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi.
3	**Poornima M. Charantimath ,** "Entrepreneurship Development and Small Business Enterprise", Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education

Reference Books	
1.	Robert L Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Robert Schmitt, "Construction Planning, Equipment, and Methods (Civil Engineering), McGraw-Hill Education
2.	Harold Koontz, Heinz Weihrich, "Essentials of Management: An International, Innovation, and Leadership perspective", T.M.H. Edition, New Delhi

SEMESTER II		
PAVEMENT MANAGEMENT SYSTEMS (Theory)		
Course Code: MVJCTE2063		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Recall the importance of evaluation and strengthening of pavements	
2	Introduce the various methods of structural and functional evaluation of rigid and flexible pavements	
3	Discuss the need for pavement management and explain the techniques involved	
4	Formulate the development and application of models for pavement management.	
Module-1		
Pavement Evaluation : Introduction- Structural and functional requirements of flexible and rigid pavement; pavement distress; different types of failures, causes and remedial measures.		**8Hrs**
Module-2		
Functional evaluation of pavements : Evaluation of Surface Condition: Methods of evaluating pavement surface condition, PCI & PSI measurement of skid resistance and unevenness by various methods, their applications.		**8Hrs**
Module-3		
Structural evaluation of pavements: Evaluation by non- destructive tests such as FWD, Benkelman Beam rebound deflection using BBD for flexible overlay design, Plate load test, wave propagation and other methods of load tests, evaluation by destructive test methods, and specimen testing.		**8Hrs**
Module-4		
Pavement management: Historical Background -General nature and applicability of systems methodology, basic components of Pavement Management System, planning pavement investments. Design Strategies - Framework for pavement design – design objectives and constraints.		**8Hrs**
Module-5		
Basic structural response models: Characterization of physical design inputs – generating alternative pavement design – economic evaluation of alternative design – analysis of alternative design strategies – selection of optimal design strategy. Techniques for developing prediction models – AASHTO, CRRI and HDM models		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand importance of evaluation and strengthening of pavements
CO2	Analyse the methods of pavement surface evaluation
CO3	Understand various methods of structural and functional evaluation of rigid and flexible pavements
CO4	Develop a framework for efficient pavement design
CO5	Formulate the development and application of models for pavement management

TextBooks	
1.	Ralph Haas, W.Ronald Hudson and John Zaniewski, “Modern Pavement Management”, Kreigar Publishing Company, New York(1994)
2.	Yoder, E.J., and Witzack, ‘Principles of Pavement Design’, 2 nd Edition, John Wiley and Sons (1991)
3.	M.Y.Stalin, Chapman and Hall Pavement Management for Airports, Roads and Parking Lots, New York
4.	Michael Sargious, Pavements and surfacings for Highways and Airports, Applied Science Publishers Limited, London, 1975

ReferenceBooks	
1.	Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co.1978.
2.	Relevant IRC Standards

SEMESTER II		
INFRASTRUCTURE MANAGEMENT AND EIA ON TRANSPORTATION **(Theory)**		
Course Code: MVJCTE2064		**CIE Marks: 50**
Credits: L:T:P: 3:0:0		**SEE Marks: 50**
Hours: 40L		**SEE Duration: 3Hrs.**
Course Learning Objectives: The students will be able to		
1	Discuss the need of Infrastructure Management in planning and maintaining the Infrastructures	
2	Discuss the performance of Infrastructures, causes of failure, rating methods	
3	Discuss the need of application of methods of prioritization and application of innovative methods.	
4	Explain the impacts of transportation related components on environment	
Module-1		
Introduction: The Challenge of Managing Infrastructure- Infrastructure and Society- Definition Infrastructure Assets-Life Cycle Analysis-Infrastructure Crisis-Infrastructure Management- An integrated approach.		**8Hrs**
Module-2		
Infrastructure Management: Framework for Infrastructure Management: Background-Key Issues Application of system Methodology-Development of IMS- Life cycle analysis Concept. Planning, Needs, Assessment and Performance Indicators: Planning-Examples on planning- Life Cycle Management-Infrastructure Service life-Needs Assessments- Performance.		**8Hrs**
Module-3		
Evaluation Technologies: Database Management: Information Management-Database Development and Management- Needs-Analysis and Modelling Techniques-Security-Quality Control and assurance Issues. In-service Monitoring and Evaluation Data: - Needs- In service evaluation of Physical assets- Technologies for Evaluation- Methods-Issues- examples-Road and Airport Pavements-Railroad Tracks-Bridges- Buildings.		**8Hrs**
Module-4		
Environmental Issues in Industrial Development: On-site and Off-site impacts during various stages of industrial development, Long term climatic changes, Greenhouse effect, Industrial effluents and their impact on natural cycle, Environmental impact of Highways, Mining and Energy development.		**8Hrs**
Module-5		
Environment and its interaction with human activities- Environmental imbalances – Attributes, Impacts, Indicators and Measurements-Concept of environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA.		**8Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the role of infrastructure in society and explain key concepts such as infrastructure assets, life cycle analysis, and the infrastructure crisis.
CO2	Apply an integrated infrastructure management framework using systems methodology and life cycle concepts for effective planning and performance monitoring.
CO3	Analyze infrastructure needs using database management techniques, in-service monitoring, and performance evaluation for various physical assets like roads, bridges, and buildings.
CO4	Evaluate the environmental impacts of industrial development and infrastructure projects considering both on-site and off-site effects and long-term environmental consequences.
CO5	Explain environmental imbalances and assess the need for Environmental Impact Assessment (EIA), including its attributes, indicators, objectives, and limitations in project planning.

Text Books	
1.	**Hudson, W. R., Haas, R., & Uddin, W.** (1997). *Infrastructure Management: Design, Construction, Maintenance, Rehabilitation, Renovation*. McGraw-Hill, New York.
2.	**Grigg, N. S.** (1988). *Infrastructure Engineering and Management*. John Wiley & Sons, New York.
3.	**Hudson, W. R., Haas, R., & Zeniewski, M.** (Year Not Specified). *Modern Pavement Management*. McGraw-Hill, New York.
4.	**Jain, R. K., Urban, L. V., & Stacey, G. S.** (1991). *Environmental Impact Analysis*. Van Nostrand Reinhold Co., New York.

Reference Books	
1.	**Rau, J. G., & Wooten, D. C.** (1996). *Environmental Impact Assessment*. McGraw-Hill Publishing Co., New York.
2.	**Moser, D. A., & Kalton, J. R.** (1993). *Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation

SEMESTER II		
TRAFFIC ENGINEERING LAB (Practice)		
Course Code: MVJCTEL207		**CIE Marks: 50**
Credits: L: T: P: 1:0:1		**SEE Marks: 50**
Hours: 30		**SEE Duration: 3 Hrs.**
Course Learning Objectives: The students will be able to		
1	To enable students to understand and apply methods for traffic data collection, including volume counts, speed studies, travel time analysis, and origin-destination surveys.	
2	To develop proficiency in using manual and automated tools for analyzing traffic behavior, congestion patterns, and traffic stream parameters.	
3	To build the ability to critically interpret traffic data for practical applications like traffic management, highway capacity analysis, and transportation planning.	

LABORATORY EXPERIMENTS

1. Spot speed studies and analysis
2. Travel time and delay studies using by manual methods
3. Moving observer method for traffic stream analysis
4. Origin–destination surveys using license plate matching
5. Parking usage surveys and analysis
6. Acceleration and deceleration characteristics of vehicles
7. Intersection volume studies
8. Saturation flow measurement at intersections.

Course Outcomes: After completing the course, the students will be able to	
CO1	Conduct traffic surveys (volume, speed, O-D surveys) and accurately collect and organize real-world traffic data.
CO2	Analyze and interpret traffic flow characteristics using various techniques such as moving observer and spot speed methods.
CO3	Propose practical traffic management solutions based on the analysis of collected field data, enhancing road safety and efficiency.

Reference Books	
1.	**“Transportation Engineering: An Introduction”** by C. Jotin Khisty and B. Kent Lall
2.	**“Highway Traffic Analysis and Design”** by R. J. Salter and N. B. Hounsell
3.	**IRC: 106-1990** "Guidelines for Capacity of Urban Roads in Plain Areas" and other relevant codes.