Course Title	**ADVANCED TRAFFIC ENGINEERING**	Semester	I
Course Code	MVJ20CTE11	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 00 : 20	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	4	**Exam. Duration**	3 Hrs

Course objective is to:

- Provide an insight on traffic and its components, factors affecting road traffic and the design of intersection.
- Explain sampling of data, analysis and interpretation of data in conducting various surveys.
- Explain traffic movements, types of intersections, islands, crossings and their design.
- Illustrate the design of signals and explain the redesigning of existing signals.
- Provide an insight on traffic regulations, pollution caused by traffic and the method of controlling pollution

Module-1	**L3**	**12Hrs**

Prerequisites: *Knowledge on Traffic and traffic causing components.*

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.

Laboratory Sessions/ Experimental learning: Collecting data of human and vehicle characteristics and PCU of vehicles coming to institution.

Applications:

- Able to gain practical knowledge on traffic causing components

Video link:

- https://nptel.ac.in/courses/105101008/

Module-2	**L3**	**12Hrs**

Prerequisites: *Knowledge on different types of traffic studies.*

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).

Laboratory Sessions/ Experimental learning: Survey on above topics for the live traffic movements.

Applications:

- Knowledge on traffic data and its analysis, also can obtain with solution.

Video Link:

- https://nptel.ac.in/courses/105101008/

Module-3	**L3**	**12Hrs**

Prerequisites: *Knowledge on traffic deviators.*

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.

Laboratory Sessions/ Experimental learning:

- Design and Model making on traffic facilities.

Applications:

- Can obtain solutions for traffic facilities for traffic at intersections.

Module-4	**L3**	**12Hrs**

Prerequisites: *Knowledge on traffic signals.*

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.

Laboratory Sessions/ Experimental learning:

- Study on existing signal timings

Applications:

- Can obtain solutions for traffic facilities for traffic intersections.

Module-5	**L3**	**12Hrs**

Prerequisites: *Knowledge on effect of traffic on environment.*

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.

Laboratory Sessions/ Experimental learning:

- Analysis of road accidents and parking problem.

Applications:

- Can obtain the solutions for road accidents and parking problems by promoting public transport.

Course outcomes: On completion of the course, students would 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.

Reference Books:

1.	Drew D R "traffic flow theory and control", McGraw Hill Book Co.
2.	Papacostas, C A. "Fundamentals of Transporttation 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
5	IRC-106-1990 Guidelines for Capacity of Urban Roads in Plain Areas

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	2	1	1	2	2	1	2
CO2	3	3	3	3	1	1	1	1	2	1	2	2
CO3	3	3	3	3	2	1	-	1	2	1	2	2
CO4	3	2	3	2	-	1	1	1	2	1	1	2
CO5	3	2	2	2	2	2	1	1	2	1	1	2

High-3, Medium-2, Low-1

Course Title	**PAVEMENT MATERIALS AND CONSTRUCTION**	Semester	I
Course Code	MVJ20CTE12	**CIE**	50
Total No. of Contact Hours	60 L : T : P :40 ::0::20	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	4	**Exam. Duration**	3 Hrs

Course objective is to:

- Explain the properties of aggregates and different test procedures and specifications and to know about the new alternative materials for road construction
- Explain the origin, properties, constituents and preparation of bitumen, tar, cutback bitumen and emulsions.
- Explain in detail about HMA, WMA, CMA and Illustrate the bituminous mix design method.
- Provide information on specifications of construction of different types of granular subbase, base and surface course and construction of special pavement
- 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	**L3 & L4**	**12 Hrs.**

Aggregates:

Prerequisites: Knowledge on basic Highway Engineering materials.

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 materials- characteristics and application in highways

Laboratory Sessions:

- Basic tests on Aggregates.

b) Marshal Stability Test.

Applications:

- To find out the Physical requirements of Aggregates with respect to IRC specifications.
- To find out the Optimum Binder Content for Bituminous Mixes.

Video link / Additional online information:

- https://www.youtube.com/watch?v=49yGZYeokKM

- https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-26.pdf
- https://www.youtube.com/watch?v=fqYK4JGIVJY
- https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-24.pdf

e) https://youtu.be/_C4A6030w08

Module-2	L3 & L4	12 Hrs.

Bitumen:

Prerequisites: Knowledge on basic Highway Engineering materials.

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.

Laboratory Sessions:

- Basic tests on bitumen.

Applications:

- To find out the Physical requirements of Bitumen with respect to IRC specifications.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105106053/lec31.pdf
- https://nptel.ac.in/courses/105105107/

  c) https://youtu.be/Y8kNjFbgV-I

Module-3	L3 &L4	12 Hrs.

Bituminous Mixes:

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.

Laboratory Sessions/ Experimental learning:

- Rutting test and Fatigue test
- Marshall Mix Design

Applications:

- To determine the stability of the mix
- To Prepare the stable bituminous mix for the road construction

Video link / Additional online information (related to module if any):

- https://youtu.be/fqYK4JGIVJY
- https://youtu.be/NVVpaOXwtHA

c) https://www.youtube.com/watch?v=U15QWxoz_mc

Module-4	**L3& L4**	**12 Hrs.**

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 and stabilized soil road construction.

Laboratory Sessions/ Experimental learning:

- Refer standard contract forms and identify important clauses.

Applications:

- Equipment selection.

Video link / Additional online information:

- https://nptel.ac.in/courses/105103093/,
- https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105104161/lec12.pdf,
- https://syedsohailuddin.files.wordpress.com/2018/07/is-1200-17.pdf.

Module-5	**L3**	**12 Hrs.**

Pavement construction

Prerequisites: Knowledge on basic Highway Engineering materials.

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 checks for of flexible pavement layers –BM- DBM and BC Cement Concrete Pavements: – PQC-FRCC- Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints

Laboratory Sessions/ Experimental learning:

- Compaction Test(density)
- Quality tests of aggregate.
- Quality test on the Bituminous and cement concrete during the construction

Video link / Additional online information (related to module if any): https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-19.pdf	
Course outcomes: On completion of the course, students would 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 equipments

Reference 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
4.	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.
5	Peurifoy.R.L., 'Construction Planning, Equipment and Methods', McGraw Hill Publishers, New York,2000.
6	S.C.Sharma, 'Construction Equipment and its Management', Khanna Publishers, New Delhi, 1988.
7	Relevant IRC ,MoRTH and AASHTO Publications

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	1	-	2	1	-	1
CO2	3	3	1	2	-	1	1	-	2	1	1	1
CO3	3	3	2	1	-	1	-	-	2	1	-	1
CO4	3	3	2	2	-	1	1	-	2	1	-	1
CO5	3	3	2	2	2	2	1	-	2	1	1	1

High-3, Medium-2, Low-1

Course Title	**APPLIED SOIL MECHANICS AND GROUND IMPROVEMENT TECHNIQUES**	Semester	I
Course Code	MVJ20CTE13	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	04	**Total**	100
Credits	04	**Exam. Duration**	3 Hrs

Course objective is to:

This course will enable students to:

- Explain the origin, formation, classification of soil, index properties and their determination, types of soil exploration programmes
- Provide information shear strength of soil and its measurement, elastic properties of soil
- Explain various ground improvement techniques and the types of compaction and its effect on soil properties
- Explain the types of drains and various stabilization techniques
- Inform about the types of reinforcement and design principles, grouting techniques

Module-1	**L3**	**12 Hrs**

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, numericals on these.

Site Investigation: Introduction, Planning exploration programmes, Types of Exploration, Location and depth of Borings, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

Laboratory sessions:

- Index properties of soil

Applications:

- SPT, SCPT & DCPT

Video link:

- https://nptel.ac.in/courses/105101201/

Module-2	L3	12 Hrs.
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 Laboratory sessions: • Shear parameters of soil Video link: • https://nptel.ac.in/courses/105101201/		
Module-3	**L3**	**12 Hrs.**
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 Case study: Dynamic compaction, Vibro-floatation Video link: • https://nptel.ac.in/courses/105108075/		
Module-4	**L3**	**12 Hrs.**
Hydraulic Modification And Chemical Modification Hydraulic modification –Definition, gravity drain, lowering of water table, multistage well point, vacuum 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. Application: • Soil Stabilization Video link: • https://nptel.ac.in/courses/105108075/		

Module-5	L3	12 Hrs.

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.

Miscellaneous Methods (Only Concepts & Uses):

Grouting: Introduction, Effect of grouting. Chemicals and materials used. Types of grouting, grouting procedure, Applications of grouting. Thermal methods, Crib walls, Gabions and Mattresses, Anchors, Rock bolts, Stone Column, Micropiles, Case studies

Video link:

- https://nptel.ac.in/courses/105108075/

Course outcomes: After the completion of the course students should be

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

Reference 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
4	FreddyLRoberts, Prithvi S Kandhalet al, "Hot Mix Asphalt Materials, mixture design and construction"- (2ndEdition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.
5	Relevant IRC and MoRTH Publications.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	1	1	1	1	1	1	1
CO2	2	2	2	2	2	1	1	1	1	1	1	1
CO3	2	1	1	2	2	2	1	1	1	1	1	1
CO4	3	2	2	1	1	2	2	1	1	1	1	1
CO5	2	2	1	1	2	1	2	1	1	1	1	1

High-3, Medium-2, Low-1

Course Title	**URBAN TRANSPORT PLANNING**	Semester	I
Course Code	MVJ20CTE14	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

- Recall basic concepts and methods of urban transportation planning in the India.
- Summarize methods of designing, conducting and administering surveys to provide the data required for transportation planning.
- Examine and apply travel demand modelling, Mode Choice Modelling and Traffic Assignment Modelling.
- Formulate the need of land use modelling and illustrate land use models for urban transportation planning

Module-1	**L3**	**12 Hrs.**

Prerequisites: *Knowledge in the fundamentals of Traffic and Transportation Engineering*

Introduction to transportation planning: scope and objective of UTP, various modes of transportation and comparisons, urban transportation system planning process, transportation demand and forecast.

Laboratory Sessions/ Experimental learning:

- Model making of Rail network for domestic transport system and its comparison.
- Preparation of flowchart and model of urban transport system planning process and its functioning methodology.

Applications:

- Understanding the basics of transportation and study of various modes of transport.
- Knowledge of the scope of the subject with latest advancements in urban transportation system.

Video link / Additional online information:

- https://nptel.ac.in/courses/105107067/
- https://nptel.ac.in/courses/105106058/

Module-2	**L3**	**12 Hrs.**

Transportation Planning Process & Surveys:

Prerequisites: Knowledge in the fundamentals of Traffic and Transportation Engineering.

System approach to urban planning, Stages in transportation planning, Basic Movements-Study Area-Zones-Surveys-Planning of different types of surveys-Inventory of transportation facilities.

Laboratory Sessions/ Experimental learning:

- Practical conduction of different types of road surveys and preparation of road survey report and its presentation.
- Collection of data on the inventory of transportation facilities and summarization of the various transportation facilities.

Applications:

- Understanding the stages of Urban Transportation Planning Process.
- Practical challenges and difficulties in conduction of road surveys and its possible overcomes.

Video link / Additional online information:

- https://nptel.ac.in/courses/105107067/
- https://nptel.ac.in/courses/105106058/

Module-3	**L3**	**12 Hrs.**

Trip generation & Trip distribution:

Prerequisites: Knowledge in the fundamentals of Traffic and Transportation Engineering and Probability and Statistics.

Trip generation: Trip purpose- Factors governing trip generation and attraction- Category analysis- Numericals on above

Trip distribution: Methods- Growth factors methods- Synthetic methods- Fratar and Furness method and numericals on the above

Laboratory Sessions/ Experimental learning:

- Questionnaire preparation on the possible reasons for making trips and distribution to road users and consolidation of the answers.
- Model making and presentation on various trip distribution methods.

Applications:

- Public opinion on their purpose of making trips daily and on weekends.
- Better knowledge can be attained in the proper distribution of trips.

Video link / Additional online information:

- https://nptel.ac.in/courses/105107067/
- https://nptel.ac.in/courses/105106058/

Module-4	L3	12 Hrs.

Modal Split & Trip Assignment:

Model Split: Factors affecting- characteristics of split- Model split in urban transport planning- numericals on above

Trip Assignment: Assignment techniques- numericals on all techniques, minimum path tree numericals.

Laboratory Sessions/ Experimental learning:

- Model preparation of Minimum Path Tree method and its application.
- Preparation of flowchart and schematic presentation of pre –distribution and post – distribution modal split models.

Applications:

- Understanding the use of Modal Split in Planning of urban transportation systems and its advancements.
- Finding the minimum path tree of the existing routes and diversion of traffic to reduce time and energy/fuel.

Video link / Additional online information (related to module if any):

- https://nptel.ac.in/courses/105107067/
- https://nptel.ac.in/courses/105106058/

Module-5	L3	12 Hrs.

Interdependency of Land Use & transport

characteristics of land use Models–Lowry Model- Hansen's Accessibility Model-Density- Saturation Gradient Model-Numericals(Exception Lowry Model & DSGM)- Difficulties in planning small & medium cities- Recent case studies

Laboratory Sessions/ Experimental learning:

- Model making of Lowry Model and its practical applications.
- Flowchart preparation and procedure followed in planning of transport system in medium and small cities including the various government and PWD organizations

Applications:

- Practical problems faced during the transport planning can be understood and feasible solutions can be expected taking into consideration the real time difficulties.

Video link / Additional online information (related to module if any):

- https://nptel.ac.in/courses/105107067/
- https://nptel.ac.in/courses/105106058/

Course outcomes:	
CO1	Know about methods of urban transportation planning in the India.
CO2	Able to apply knowledge of methods of designing Mode Choice.
CO3	Able to apply knowledge of travel demand modelling.
CO4	Able to apply knowledge of trip modal split modelling and Traffic Assignment Modelling.
CO5	Able to gain knowledge of land use modelling.

Reference Books:	
1.	Kadiyali L.R., Traffic Engineering and Transport Planning, Khanna Publishers
2.	C. S. Papacostas, Fundamentals of Transportation System Analysis, PHI.
3.	Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ
4.	B.G.Hutchinson, Principles of urban transportation system planning- McGraw-Hill, New York, 1974
5.	S.C. Saxena, *Traffic Planning and Design*, DhanpatRai Pub., New Delhi.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	1	-	2	1	-	1
CO2	3	3	1	2	-	1	1	-	2	1	1	1
CO3	3	3	2	1	-	1	-	-	2	1	-	1
CO4	3	3	2	2	-	1	1	-	2	1	-	1
CO5	3	3	2	2	2	2	1	-	2	1	1	1

High-3, Medium-2, Low-1

Course Title	**APPLIED STATISTICS**	Semester	II
Course Code	MVJ20CTE15	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

- Explain different statistical methods used in transportation engineering problems, measures of central tendency, correlations methods.
- Illustrate the use of probability and discrete distributions in transportation engineering problems.
- Explain significance testing to check goodness of fit.
- Explain time series analysis.
- Explain different graphical methods and statistical software packages useful in transportation engineering field.

Module-1	**L3**	**12 Hrs.**

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

Laboratory Sessions/ Experimental learning:

- Data analysis using graphical representation

Applications:

- Test and verification of principles or hypothesis
- Understand to draw histogram for the given frequency distribution of travel time of vehicle

Video link / Additional online information:

- https://nptel.ac.in/courses/105/105/105105150/

Module-2	**L3**	**12 Hrs.**

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

Laboratory Sessions/ Experimental learning:

- Data collection for solving traffic engineering problems

Applications:

- Understand the usage of Regression methods to construct model related to Highway related problems
- To understand and study the highway engineering problems

Video link / Additional online information:

- https://nptel.ac.in/courses/105/103/105103027/

Module-3	L3	12 Hrs.

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

Laboratory Sessions/ Experimental learning:

- Use of statistics and its analysis in resolving transportation related problems

Applications:

- Theory of probability provides a deductive framework for evaluating the probability of different types of events in transportation system

Video link / Additional online information:

- https://nptel.ac.in/courses/105/105/105105138/

Module-4	L3	12 Hrs.

Time series analysis: Introduction –moving average- Problems.

Laboratory Sessions/ Experimental learning:

- Data analysis using Scilab

Applications:

- Application of time series analysis for traffic forecasting
- Application of time series analysis for dataset produced by transportation system

Video link / Additional online information:

- https://nptel.ac.in/courses/103/106/103106123/

Module-5	L3	12 Hrs.

Optimization technique and applications: Graphical Method –Simplex Method-Big-Mmethod-2–Phase Simplex method-applications in Highway engineering problems Use of mathematical and statistical software packages.

Laboratory Sessions/ Experimental learning:

- Graphical method of optimization techniques
- Data analysis using SPSS software

Applications:

- Understand the application of mathematical and statistical software's in highway engineering problems

Video link / Additional online information:

- https://nptel.ac.in/courses/111/105/111105077/

Course outcomes: On completion of the course, students would be able to	
CO1	Able to use appropriate statistical method in transportation engineering problems.
CO2	Capable of applying the rule of probability and discrete distributions in solving problems.
CO3	Capable of testing the goodness of fit by using statistical decision.
CO4	Able to understand the time series analysis
CO5	Able to apply the knowledge of optimization technique and use statistical software in analysis of transportation engineering problems.

Reference Books:	
1.	Gupta,S.C.andKapoor V.K. Fundamentals of Mathematical statistics,(2000)
2.	SultanChandandSons,1978.MedhiJ(1982)Introductiontostatistics.Newagepublications,NewDelhi
3.	WalpoleR.E.andR.H.Mayers (1982) ProbabilityandstatisticsforEngineersandScientists WileyIntl.2002.
4.	Johnson Rand G.Bhattacharya (1985): Statistics– principles and methods. JohnWiley,NY
5.	Ross S.M.Probability and statistics for Engineers.WileyInt.Edition.(2002)

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	1	-	2	2
CO2	3	2	-	-	-	-	-	-	2	-	2	2
CO3	3	1	-	-	1	-	-	-	1	-	1	2
CO4	3	2	-	1	1	-	-	-	1	-	1	2
CO5	3	1	-	-	1				1	-	-	2

High-3, Medium-2, Low-1

Course Title	**HIGHWAY MATERIALS TESTING LAB**	Semester	II
Course Code	MVJ20CTEL16	**CIE**	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	**SEE**	50
No. of Contact Hours/week	04	**Total**	100
Credits	02	**Exam. Duration**	3 Hrs

Course objective is to:

- Explain the properties of aggregates and different test procedure of conduction and specifications
- Explain procedures of conducting tests on neat bitumen and modified bitumen.
- Explain Rothfutch method of marshal mix design

Prerequisites: Material properties of Aggregates and bitumen.

S.NO	**Experiments**	**L3,L4**
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 Abrassion 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.	

Video Link:

- http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Transportation_Engineering_Lab/labs/index.html

Course outcomes: On completion of the course, students would be able to

CO1	Able to test the aggregates for different properties

CO2	Able to test neat and modified bitumen
CO3	Qualified to design bituminous mix Rothfutch method of marshal mix design
Reference Books:	
1.	Highway Material Testing – S K Khanna- C.E.G. Justo , and Veeraraghavan A Nemchand Bros- Rookee, 2010
2.	Relevant IS and IRC Publications
3.	Relevant ASTM Standards

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	2	1	1	2	2	1	2
CO2	3	3	3	3	1	1	1	1	2	1	2	2
CO3	3	3	3	3	2	1	-	1	2	1	2	2

High-3, Medium-2, Low-1

Course Title	**CONCRETE MATERIALS TESTING LAB**	Semester	I
Course Code	MVJ20CTEL17	**CIE**	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	**SEE**	50
No. of Contact Hours/week	04	**Total**	100
Credits	02	**Exam. Duration**	3 Hrs

Course objective is to:

- To learn the procedure of testing concrete ingredients and properties of concrete as per standard code recommendations.
- To learn the procedure of testing bituminous materials as per standard code recommendations.
- To relate material characteristics to various application of construction.

Module-1	**L1, L2, L3**

Test on Soils

- Determination of Bearing Capacity by CBR test
- Determination of density by Compaction Tests

Tests on Cement

- Determination of Normal Consistency, Setting time, Compressive strength, Fineness test and Specific gravity

Module-2	**L2, L3,L4,L5**

Tests on Concrete:

- Design of concrete mix as per IS-10262

Tests on fresh concrete:

- Determination of Slump of fresh concrete
- Determination of compaction factor of fresh concrete
- Determination of consistency of fresh concrete by Vee Bee test

Tests on hardened concrete:

- Determination of compressive strength of hardened concrete
- Determination of split tensile strength of hardened concrete
- Determination of flexural strength of hardened concrete
- Estimation of elastic property of concrete through NDT tests by re bound hammer and pulse velocity test.

Module-3	L2, L3,L4,L5

Tests on Self Compacting Concrete

- design of self-compacting concrete as per IS 10262:2019
- Conducting slump flow test to determine the workability of self-compacting concrete
- Conducting V-funnel test to determine the flow time of self-compacting concrete
- Conducting J-Ring test to determine the passing ability of self-compacting concrete
- Conducting U Box test to determine the filling ability of self-compacting concrete
- Conducting L Box test to determine the filling and passing ability of self-compacting concrete

Video Link:

- https://youtu.be/sl0smPfvVAo?t=140
- https://youtu.be/yzpWGrh9j6Y
- https://youtu.be/QnYaFsJ2ous

Course outcomes:

CO1	Able to interpret the experimental results of concrete based on laboratory tests.
CO2	Determine the quality and suitability of cement.
CO3	Design appropriate concrete mix Using Professional codes.
CO4	Determine strength and quality of concrete.
CO5	Evaluate the strength of structural elements using NDT techniques.

Reference Books:

1.	M. L. Gambir, “Concrete Manual”, Danpat Rai and sons, New Delhi
2.	Shetty M.S, “Concrete Technology”, S. Chand &Co. Ltd, New Delhi.
3.	Mehta P.K, “Properties of Concrete”, Tata McGraw Hill Publications, New Delhi.
4.	Neville AM, “Properties of Concrete”, ELBS Publications, London.
5.	Relevant BIS codes.
6.	S K Khanna, C E G Justo and A Veeraragavan, “Highway Materials Testing Laboratory Manual”, Nem Chand Bros, Roorkee.
7.	L R Kadiyali, “Highway Engineering”, Khanna Publishers, New Delhi.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	-	2	1	1	2	1	1	1
CO2	3	3	2	2	1	2	2	1	2	1	2	2
CO3	3	3	3	2	1	1	-	1	2	1	2	2
CO4	3	2	3	2	-	1	1	1	2	1	1	2
CO5	3	2	2	2	2	2	1	1	2	1	1	2

High-3, Medium-2, Low-1

Course Title	**RESEARCH METHODOLOGY AND IPR**	Semester	I
Course Code	MVJ20IPR18	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/Week	2	**Total**	100
Credits	2	**Exam Duration**	3Hrs

Course objective is to: This course will enable the students to

- Give an overview of the research methodology and explain the technique of defining a research problem
- Explain the functions of the literature review in research.
- Explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs and their characteristics
- Explain the details of sampling designs, and also different methods of data collections.
- Explain the art of interpretation and the art of writing research reports.
- Explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.

Module-1	**L3**	**12Hrs**

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, **Research Ethics** and Problems Encountered by Researchers in India.

Laboratory Sessions/Experimental learning:

- Formulating Case study report on Problems Encountered by the Scholar's involved in research

Applications:

- Research Design
- Layout Plan for Alternatives

Module-2	**L3**	**12Hrs**

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of

Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Laboratory Sessions/Experimental learning:

- Developing Conceptual Framework for Literature review under given issues

Applications:

- Review Paper Preparation
- Article Preparation for Research

Video link / Additional online information:

- Review of Literatures: https://nptel.ac.in/courses/110/105/110105091/

Module-3	**L3**	**12Hrs**

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Design of Sample Surveys: Introduction, Sample Design, Sampling and Non- sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Laboratory Sessions/Experimental learning:

- Preparation of particular layout for different types of sampling design

Applications:

- Strategy Planning for Resource Management
- Alternatives Risk Management

Video link / Additional online information:

- Qualitative Research : https://nptel.ac.in/courses/109105115/

Module-4	**L3**	**12Hrs**

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method **– Advanced Computing Techniques, Development of Software**

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout, **Records and Lab report**

Laboratory Sessions/Experimental learning:

- Formulating Layout of Research Report for the given research work

Applications:

- Thesis Writing
- Journal Writing

Video link / Additional online information:

- Report Writing: https://nptel.ac.in/courses/121106007/

Module-5	L3	12Hrs

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR.World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection. Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Laboratory Sessions/Experimental learning:

- Formulating Patent Draft for Provision Specifications with detailed diagrams

Applications:

- Provisional and Detailed Specification for filing the patent
- Design patenting

Video link / Additional online information:

• Intellectual Property Rights: https://nptel.ac.in/courses/110105139/	
Course outcomes: On completion of the course, students would be able to	
CO1	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
CO3	Explain various research designs and their characteristics.
CO4	Explain the art of interpretation and the art of writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Reference Books:	
1.	Santhakumar R, (2007) "Concrete Technology"-Oxford University Press, New Delhi,3rd Edition, 2007.
2.	Short A and Kinniburgh.W, "Light Weight Concrete"- Asia Publishing House,3rd Edition 1978.
3.	Aitcin P.C. "High Performance Concrete"-E and FN, Spon London, 2nd Edition 2004.
4.	Rixom.R. and Mailvaganam.N., "Chemical admixtures in concrete"- E and FN, Spon, London, 2nd Edition 2000

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	-	-	1	2	3	1	-	1
CO2	3	2	2	3	2	-	3	3	1	1	-	3
CO3	2	1	-	-	-	3	2	2	3	1	3	2
CO4	1	1	2	-	1	3	3	3	1	-	1	1
CO5	2	2	1	3	3	2	3	2	1	2	3	1

High-3, Medium-2, Low-1

Course Title	**PAVEMENT DESIGN AND ANALYSIS**	Semester	II
Course Code	MVJ20CTE21	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 10 : 10	**SEE**	50
No. of Contact Hours/week	4	**Total**	100
Credits	4	**Exam. Duration**	3 Hrs

Course objective is to:

- Identify and categorize the factors affecting design and performance of pavements.
- Explain the basic methods and concepts used to analyse flexible and rigid pavements.
- Explain different design methods for flexible and rigid pavement design.
- Explain Structural and functional requirements of flexible and rigid pavements.

Module-1	**L3,L4 & L5**	**12 Hrs.**

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.

Video link / Additional online information:

- https://youtu.be/exctAga2KXY
- https://youtu.be/E3LVFRCbero
- https://youtu.be/0yEBWxhms1I

Module-2	**L3,L4 & L5**	**12 Hrs.**

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.

Video link / Additional online information:

- https://youtu.be/a-2XUcbdJiw
- https://www.civil.iitb.ac.in/~kvkrao/uploads/5/9/3/7/59372049/ce742lec4.pdf
- https://www.civil.iitb.ac.in/~kvkrao/uploads/5/9/3/7/59372049/ce742lec3.pdf

Module-3	**L1, L2 & L3**	**12 Hrs.**

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

Video link / Additional online information :

- https://www.youtube.com/watch?v=uJntLOgEHD4
- https://youtu.be/exctAga2KXY
- https://youtu.be/uJntLOgEHD4
- https://youtu.be/JFBhIF09-8s

Module-4	**L3,L4 & L5**	**12 Hrs.**

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.

Video link / Additional online information:

- https://youtu.be/exctAga2KXY
- https://www.civil.iitb.ac.in/~kvkrao/uploads/5/9/3/7/59372049/ce742lec_8_11.pdf
- http://www.cdeep.iitb.ac.in/webpage_data/nptel/Civil%20Engineering/Transportation%20Engg%20I/29-Ltexhtml/nptel_ceTEI_L29.pdf

Module-5	**L3,L4 & L5**	**12 Hrs.**

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

Video link / Additional online information:

- https://youtu.be/GxXONAINMBE
- https://youtu.be/pe7ycTC1W_M
- https://youtu.be/CX-qs752-x4

Course outcomes: On completion of the course, students would be able to

CO1	Understand the various factors affecting design and performance of pavements.
CO2	Compute the stresses and deflections in flexible pavement layers under the action of wheel loads.

CO3	Design the thickness of flexible pavements by different methods under different exposure conditions and materials.
CO4	Factors affecting design and performance of pavements. Types of stresses and causes.
CO5	Design the thickness of concrete pavements and joints associated with CC pavements in addition to the computation of stresses in CC pavements.

Reference Books:	
1.	Yoder, E.J., and Witczak, `Principles of Pavement Design', 2nd ed. John Wiley and Sons,1975
2.	Yang H Huang, `Design of Functional Pavements', McGraw Hill BookCo.
3.	Khanna and Justo, 'Test Book of Highway Engineering 'Nemchand brothers,Roorke-2004.
4.	Huang, 'Pavement Analysis', Elsevier Publications
5.	Pavement and Surfacing for Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.
6	Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	2	-	-	1	2	-	1
CO2	3	3	-	1	-	-	2	-	1	1	-	1
CO3	3	3	-	1	-	1	-	-	1	1	-	1
CO4	3	3	1	2	1	-	1	-	1	1	1	1
CO5	3	3	1	2	1	-	1	-	1	1	-	1

High-3, Medium-2, Low-1

Course Title	**TRANSPORTATION ECONOMICS AND EVALUATION**	Semester	II
Course Code	MVJ20CTE22	**CIE**	50
Total Contact Hours	60 L : T : P :: 40 : 00 : 20	**SEE**	50
Contact Hours/week	4	**Total**	100
Credits	4	**Exam. Duration**	3 Hrs

Course objective is to:

- Explain the basic terminology of economics and its application intransportation
- Define the concept and components involved in economicevaluation
- Explain the various methods of economic analysis and ranking ofalternatives
- Illustrate the method of economic evaluation for transportationprojects

Module-1	**L3**	**12 Hrs.**

Prerequisites: *Knowledge on demand and supply of goods*

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.

Experimental learning:

- In-situ investigation of demand and supply of various goods

Applications:

- Designing the suitable transport facility for the required demand of different goods

Video link:

- https://nptel.ac.in/courses/110/105/110105141/

Module-2	**L3 & L4**	**12 Hrs.**

Prerequisites: *Knowledge on cost and benefits for the passenger*

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.

Experimental learning:

- In-situ evaluation of construction cost and maintains cost for different pavement layers.
- In-situ evaluation of benefits offered to the road user.

Applications:

- In evaluation of cost required to construct the pavement with suitable benefits to the road user

Video link:

- https://nptel.ac.in/courses/105/107/105107123/

Module-3	**L3**	**13 Hrs.**

Prerequisites: *Knowledge on evaluation of transport cost*

Project Evaluation:

Framework of evaluation, transport planning evaluation at urban and regional levels, other evaluation procedures, environmental evaluation, safety evaluation, project financing.

Experimental learning:

- Transportation planning to improving the benefits to the road user
- Evaluation of environmental effects caused by different class of vehicles

Applications:

- In providing the suitable environment for the health and safety of people

Video link:

- https://nptel.ac.in/courses/105/107/105107067/

Module-4	**L3**	**12 Hrs.**

Prerequisites: *Knowledge on economic analysis with different models*

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.

Experimental learning:

- In-situ evaluation of Traffic problems associated with economics

Applications:

- Application economic theory in traffic assignment problem

Video link:

- https://nptel.ac.in/courses/105/101/105101008/

Module-5	L6	11 Hrs.

Prerequisites: *Knowledge on environmental affects*

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.

Experimental learning:

- Evaluation of environmental effects caused by different class of vehicles
- Environmental auditing

Applications:

- In providing the suitable environment for the health and safety of people

Video link:

- https://nptel.ac.in/courses/105/107/105107067/

Course outcomes: On completion of the course, students would be able to	
CO1	Able to understand the importance of economics in transportation engineering.
CO2	Able to understand the relation of cost and benefits to the passengers for travel.
CO3	Able to draw the framework for planning the safety programs for travellers.
CO4	Able to recognise economy related problems and able to provide the solutions.
CO5	Understanding the importance of environmental impacts related to transportation engineering

Reference Books:	
1.	Ian G. Heggie, Transportation Engineering Economics, McGraw Hill
2.	Winfrey R, Highway Economic Analysis, International Textbook Company
3.	Road User Cost Study, Central Road Research Institute, New Delhi.
4.	Dickey J.W, Project Appraisal for Developing Countries, John Wiley
5.	L R Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	1	3	1	-	-	-	1	2
CO2	3	-	-	-	2	-	-	-	1	1	1	1
CO3	3	-	2	-	1	3	-	-	-	1	1	1
CO4	1	3	2	1	1	1	-	-	-	-	-	-
CO5	1	-	-	-	2	1	3	-	-	1	1	2

High-3, Medium-2, Low-1

Course Title	**RAILWAYS AND AIRWAYS**	Semester	II
Course Code	MVJ20CTE23	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 10 : 10	SEE	50
No. of Contact Hours/week	4	Total	100
Credits	4	**Exam. Duration**	3 Hrs

Course objective is to:

- Provides the basic knowledge about the railways, components
- Provide the basic knowledge about the geometric design of points and crossings.
- Provides the basic knowledge about airports, runways, taxiways and its design.
- Provide basic knowledge about heliports, characteristics, design of heliports.

Module-1	**L3**	**12 Hrs.**

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

Laboratory Sessions/ Experimental learning:

- Collecting the information on Types of Components used in the nearest Railway station or railway track.

Applications:

- Understand The Permanent Way and complexities involved in the permanent way

Video link / Additional online information:

- https://nptel.ac.in/courses/105107123/

Module-2	**L3**	**12 Hrs.**

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.

Laboratory Sessions/ Experimental learning:

- Collecting the information on types of switches and turnouts used in nearest railway track/station.

Applications:

- Understanding the relation between safety and Geometric aspects of railway track.

Video link / Additional online information:

- https://nptel.ac.in/courses/105107123/

Module-3	**L3**	**12 Hrs.**

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

Laboratory Sessions/ Experimental learning:

- Analyzing the types of yards and platforms at a nearby railway station.

Applications:

- Understanding the challenges faced for Site selection of a railway station and providing other required facilities.

Video link / Additional online information:

- https://nptel.ac.in/courses/105107123/

Module-4	**L3**	**12 Hrs.**

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**.**

Laboratory Sessions/ Experimental learning:

- Layout planning of Airport (sketch) considering Bangalore city with justifications.

Applications:

- Understanding the challenges faced for Site selection of an airport taking into consideration air craft characteristics.

Video link / Additional online information:

- https://nptel.ac.in/courses/105107123/

Module-5	L3	12 Hrs.

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

Applications:

- To design the geometrics of Taxiway by taking different factors into consideration.

Video link / Additional online information:

- https://nptel.ac.in/courses/105107123/

Course outcomes: On completion of the course, students would be able to

CO1	To Describe about railways, The Permanent way and its different components
CO2	To analyse the importance of Geometric Design in safety of Railways
CO3	Analyse the points and crossings.
CO4	Describe about airports design and runways.
CO5	Analyze the design taxiways and heliports

Reference Books:

1.	Saxena and Arora, “Railway Engineering” Dhanpat Rai and Sons, NewDelhi
2.	M M Agarwal,” Indian Railway Track”, Jaico Publications, Bombay
3.	Khanna Arora and Jain, “Airport Planning and Design”, Nem Chand Bros, Roorkee

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	-	1	1	-	1	1	1	1	1
CO2	2	2	2	1	-	2	1	1	1	2	1	1
CO3	3	3	2	2	2	3	2	-	1	1	1	1
CO4	2	2	2	1	-	2	1	1	2	1	1	1
CO5	2	2	1	1	-	2	1	2	1	1	1	1

High-3, Medium-2, Low-1

Course Title	**GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES**	Semester	II
Course Code	MVJ20CTE24	CIE	50
Total Contact Hours	60 L : T : P :: 40 : 10 : 10	SEE	50
Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- Learn the importance of geometric design elements and the cross sectional elements.
- Learn the importance of sight distances and the components of horizontal and vertical alignment.
- Learn about the various types of intersections and their suitability.
- Learn about the various types of facilities for pedestrians, cycles, buses and parking.

Module-1	**L3**	**14 Hrs.**

Prerequisites: *Knowledge on classification of highway*

Introduction: Functional Classification of Highway systems, Objectives of highway geometric design, elements of geometric design, design controls and criteria. Cross Section Elements: Pavement surface characteristics– skid resistance, cross slope, unevenness, light reflecting characteristics. Width considerations for carriageway, formation, shoulders, kerbs, traffic barriers, medians, frontage roads, right of way.

Experimental learning:

- In-situ determination of skid resistance of the pavement surface, cross slope and unevenness

Applications:

- In highway for the safety improvement

Video link:

- https://nptel.ac.in/courses/105/101/105101087/

Module-2	**L3 & L4**	**12 Hrs.**

Prerequisites: *Knowledge on the geometric design*

Sight Distances: Types, analysis, factors affecting and design of stopping sight distance, intermediate sight distance and overtaking distance. Horizontal Alignment: Design speed, stability at curves, analysis and design of super elevation, extra widening of pavements, design of transition curves, curvature at intersections

Experimental learning:

- In-situ determination of stopping sight distance, intermediate sight distance, overtaking sight distance of the pavement.
- In-situ determination of cross scope of horizontal curve in the pavement.

Applications:

- In highway for the safe and economical journey of the passenger.

Video link:

- https://nptel.ac.in/courses/105/101/105101087/

Module-3	**L3 & L4**	**12 Hrs.**

Prerequisites: *Knowledge on the valley curve and summit curve*

Vertical alignment:

Classification of grades, change of gradients, and design of summit curves for sight distance consideration, design of valley curves for comfort and sight distance considerations. Combination of vertical and horizontal alignment including design of hairpin bends, design standards for expressways and hill roads. IRC standards and guidelines.

Experimental learning:

- In-situ determination of stopping sight distance, intermediate sight distance, overtaking sight distance in the vertical curves.
- In-situ determination of cross drainage in vertical curve.

Applications:

- In highway for the safe and economical journey of the passenger.

Video link:

- https://nptel.ac.in/courses/105/101/105101087/

Module-4	**L3 & L4**	**12 Hrs.**

Prerequisites: *Knowledge on at-grade and graded intersection*

Types of intersections: Characteristics and design considerations of at-grade intersections; different types of islands, channelization, median openings. Rotary intersections – warrants, design and suitability. Grade separated intersections - types, warrants and suitability. Interchanges and ramps.

Experimental learning: In-situ determination of at grade intersection and grade separated intersection.

Applications:

- In highway for the safe and economical journey of the passenger.

Video link:

- https://nptel.ac.in/courses/105/101/105101087/

Module-5	L3 & L4	10 Hrs.

Prerequisites: *Knowledge on importance of Drainage and IRC recommendations.*

Highway drainage: Significance and requirement of highway drainage- Design of surface drainage- numerical and sub surface drainage system- numerical. Design of filter materials types of cross drainage structures, their choice and location.

Miscellaneous Facilities: Pedestrian facilities especially on urban – types, IRC specification. Bicycle tracks -types, guidelines, and IRC design standards. Bus bays - types, guidelines and IRC design standards. Parking facilities - types, guidelines and IRC design standards.

Experimental learning:

- In-situ determination of different classification of parking space studies.

Applications:

- In highway for the safe and economical journey of the passenger.

Video link:

- https://nptel.ac.in/courses/105/101/105101087/

Course outcomes: On completion of the course, students would be able to	
CO1	Able to understand importance and design geometric elements.
CO2	Able to understand sight distances and the components of horizontal curves.
CO3	Able to understand components of vertical curves and to design.
CO4	Able to understand the design of intersections in a roadway.
CO5	Able to understand IRC recommendations for highway.

Reference Books:	
1.	AASHO,"A Policy on Geometric Design of Highways an d Streets' American Association of State Highway and Transportation Officials, Washington D.C.
2.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', Nem Chand and Bros, Roorkee, 2014.
3.	DSIR`, Roads in Urban Areas', HMSO, London.
4.	Jack E Leish and Associates, `Planning and Design Guide: At-Grade Intersections'. Illinois.Relevant IRC publications

5	IRC 86:2018- Geometric Design Standards for Urban roads and streets IRC 73:1980- Geometric Design Standards for Rural roads.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	-	1	2	1	-	-	-	-	1
CO2	3	2	2	1	-	-	-	-	-	-	1	1
CO3	2	3	3	1	1	-	1	-	-	-	-	1
CO4	2	3	1	-	-	1	-	-	-	-	1	1
CO5	1	2	-	-	-	3	1	-	-	-	1	1

High-3, Medium-2, Low-1

Course Title	**ROAD SAFETY AND MANAGEMENT**	Semester	II
Course Code	MVJ20CTE251	CIE	50
Total No. of Contact Hours	60 L : T : P :: 40 : 10 : 10	SEE	50
No. of Contact Hours/week	3	Total	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

- Explain different parameters responsible for providing road safety in the construction of new roads
- Describe road reconstruction principle and improvement of road considering the different components of road and intersections
- Discuss road safety and maintenance measures for road in operation considering pedestrian, cyclists and road furniture
- Define road safety audit principle and procedure, various traffic management techniques and their effectiveness

Module-1	**L3**	**12 Hrs.**

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.

Laboratory Sessions/ Experimental learning:

- Analyzing any accident at a nearby junction

Applications:

- Accident analysis and finding the speed of vehicles involved in the accident.

Video link / Additional online information:

- https://youtu.be/7I9Eyz9aSZs
- https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_42.pdf

Module-2	**L3**	**12 Hrs.**

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.

Laboratory Sessions/ Experimental learning:

- Surveying newly constructed road with respect to safety parameters stated in the module.

Applications:

- Understanding how different conditions affect safety on New roads.

Module-3	**L3**	**12 Hrs.**

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.

Applications:

- Analyzing the accident data for reconstruction of roads.

Module-4	**L3**	**12 Hrs.**

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.

Laboratory Sessions/ Experimental learning:

- Conducting a pedestrian safety survey at Hopeform junction and analyzing the results.

Module-5	**L3**	**12 Hrs.**

Road Safety Auditand 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.

Laboratory Sessions/ Experimental learning:

- Analyzing the safety of road with respect to engineering parameters on a stretch of road nearby.

Video link / Additional online information:

- https://youtu.be/LH8ojQIIYWw

Course outcomes: On completion of the course, students would 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. Qualified to evaluate the effectiveness of various management techniques adopted in reducing road accident.
CO5	Recognize the factors affecting the construction of new roads

Reference 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
5.	Relevant IRC Publications.
6.	MORTH "Manual for Road Safety in Road Design"- Indian Roads Congress

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	-	1	1	-	1	1	1	1	2
CO2	2	2	2	1	-	2	1	1	1	2	1	1
CO3	3	2	2	2	2	3	2	-	1	1	1	1
CO4	2	2	2	1	-	2	1	1	2	1	1	1
CO5	2	2	1	1	-	2	1	2	1	1	1	1

High-3, Medium-2, Low-1

Course Title	**INTELLIGENT TRANSPORTATION SYSTEMS**	Semester	II
Course Code	MVJ20CTE252	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to:

- Recall the scope of transport issues, such as, traffic safety, public transport, advanced vehicle management and control.
- Discuss on Intelligent transport systems (ITS) involve the application of information technology and telecommunications to control traffic.

Module-1	**L3&L4**	**12 Hrs.**

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

Module-2	**L3&L4**	**12 Hrs.**

Advanced traveller information systems; transportation network operations; commercial vehicle operations and intermodal freight

Module-3	**L3,L4 &L5**	**12 Hrs.**

Public transportation applications, ITS and regional strategic transportation planning, including regionalarchitectures.

Video link / Additional online information:

- https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_48.pdf

Module-4	**L3,L4 &L5**	**12 Hrs.**

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

Module-5	L3,L4 &L5	12 Hrs.
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. Video link / Additional online information: • https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_49.pdf		

Course outcomes:	
CO1	Describe the different techniques adopted in the Intelligent Transportation systems (ITS)
CO2	Develop the appropriate system/s in various functional areas of transportation.
CO3	Establish the integration of various systems, plan and implement the applications of ITS
CO4	Erudite the application of information technology and telecommunication systems to control traffic
CO5	Afford advance information to the travelers, automatic handling of emergencies andto improve safety

Reference Books:	
1.	Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" ArtechHouse Publisher, 2003, Pp.210
2.	Kan Paul Chen and John Miles, "Recommendations for World Road Association (PIARC)/PIRAC Committee on Intelligent Transport", Artech House, 1999, Pp.434
3.	Sussman, J. M., "Perspective on ITS", Artech House Publishers,2005
4	US Department of Transportation, "National ITS Architecture Documentation", 2007(CD-ROM)
5	Turban. E and Aronson. J. E, "Decision Support Systems and Intelligent Systems, 7th Edition", PrenticeHall of India Private Limited , 2007, Pp.960

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	-	2	-	-	1	1	1	1
CO2	2	2	1	1	-	2	-	-	1	2	1	1
CO3	2	3	1	2	3	2	1	-	2	3	2	1
CO4	2	3	3	2	3	3	2	-	2	2	2	2
CO5	3	3	3	3	2	3	2	-	3	3	3	3

High-3, Medium-2, Low-1

Course Title	**PAVEMENT EVALUATION AND MANAGEMENT**	Semester	II
Course Code	MVJ20CTE253	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

- Recall the importance of evaluation and strengthening of pavements.
- Introduce the various methods of structural and functional evaluation of rigid and flexible pavements
- Discuss the need for pavement management and explain the techniques involved
- Formulate the development and application of models for pavement management.

Module-1	**L3**	**12 Hrs.**

Pre requisites: *Concept of flexible and rigid pavements*

Pavement Evaluation : Introduction- Structural and functional requirements of flexible and rigid pavement; pavement distress; different types of failures, causes and remedial measures.

Laboratory Sessions/ Experimental learning:

- Field survey to identify the types of pavement failures in flexible and rigid pavements
- Material testing laboratory for soils, aggregates, bituminous binders and bituminous mixes

Applications:

- Knowledge on the structural and functional requirements of flexible and rigid pavement
- Understand the different types of pavement failures and the types of remedies in real life problems

Video link / Additional online information:

- http://nptel.ac.in

Module-2	**L3**	**12 Hrs.**

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.

Laboratory Sessions/ Experimental learning:

- Field methods of evaluating pavement conditions
- Standardization of Automatic Road Unevenness Recorder/ Bump Indicator test

Applications:

- Pavement performance studies can be understood
- Understand the different methods of pavement evaluation

Video link / Additional online information:

- http://nptel.ac.in

Module-3	**L3**	**12 Hrs.**

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.

Laboratory Sessions/ Experimental learning:

- Non- destructive tests such as FWD, Benkelman Beam rebound deflection using BBD

Applications:

- Understand the working methods of different type of NDT
- Knowledge about the procedure of specimen test

Video link / Additional online information:

- http://nptel.ac.in

Module-4	**L3**	**12 Hrs.**

Pre requisites: *Concept of pavement management system*

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.

Laboratory Sessions/ Experimental learning:

- Frictional properties of pavement surface

Applications:

- Practical problems faced during the planning and design can be understood
- Understand the basis of design objectives in pavement management

Video link / Additional online information:

- http://nptel.ac.in

Module-5	L3	12 Hrs.

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

Laboratory Sessions/ Experimental learning:

- AASHTO, CRRI and HDM models
- Analysis of pavement Deflection data using software

Applications:

- Understand the techniques for developing prediction models
- Development of pavement deterioration models for Indian conditions

Video link / Additional online information:

- http://nptel.ac.in

Course outcomes: On completion of the course, students would 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

Reference 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
4.	Michael Sargious, Pavements and surfacings for Highways and Airports, Applied Science Publishers Limited, London, 1975

5.	Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co.1978.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	1	1	-	1
CO2	3	3	-	1	-	-	-	-	1	1	-	1
CO3	3	3	-	1	-	-	-	-	1	1	-	1
CO4	3	3	1	2	1	-	-	-	1	1	-	1
CO5	3	3	1	2	2	-	1	-	1	1	-	1

High-3, Medium-2, Low-1

Course Title	**THEORIES OF TRAFFIC FLOW**	Semester	II
Course Code	MVJ19CTE254	CIE	50
Total Contact Hours	60 L : T : P :: 40 : 10 : 10	SEE	50
Contact Hours/week	3	Total	100
Credits	3	Exam. Duration	3 Hrs

Course objective is to:

- Learn the relationships and the types of flow theories.
- Learn the concept of Macroscopic and Microscopic traffic flow models.
- Learn the application of probabilistic aspects of vehicle arrivals, queuing theory.
- Learn the principles of application of GIS in traffic flow theory.

Module-1	**L3 & L5**	**12 Hrs.**

Prerequisites: *Knowledge on traffic flow patterns*

Traffic Stream Parameters: Fundamental diagram of volume-speed-density surface. Discrete and continuous probability distributions. Merging manoeuvres - critical gaps and their distribution.

Experimental learning:

- Average daily traffic data
- Space mean and time mean studies

Applications:

- Traffic volume studies helps in estimation of highway usage
- Traffic speed helps in allotting the speed limits in an highway

Video link:

- https://nptel.ac.in/courses/105/101/105101008/

Module-2	**L3 & L4**	**14 Hrs.**

Prerequisites: *Knowledge on macroscopic models and bottleneck*

Macroscopic Models: Macroscopic Models - Heat flow and fluid flow analogies - Shock waves and bottleneck control approach.

Experimental learning:

- In-situ identification of bottleneck in the highway
- In-situ identification of shock waves in the highway

Applications:

- Reduction in accident rates in the highways
- Determination of slow moving vehicles

Video link:

- https://nptel.ac.in/courses/105/101/105101008/

Module-3	**L3 & L4**	**10 Hrs.**

Prerequisites: *Knowledge on microscopic models and distribution of traffic*

Microscopic Models: Microscopic Models - Application of queuing theory - regular, random and Erlang arrival and service time distributions - Queue discipline - Waiting time in single channel queues and extension to multiple channels.

Experimental learning:

- In-situ evaluation of traffic que in the Toll and arrival pattern

Applications:

- Identification of time spent in que

Video link:

- https://nptel.ac.in/courses/105/101/105101008/

Module-4	**L3 & L4**	**12 Hrs.**

Prerequisites: Knowledge on traffic models

Traffic models: Linear And Non-Linear Car Following Models - Determination of car following variables -Acceleration noise.

Experimental learning:

- Floating car method

Applications:

- Identification of traffic speed

Video link:

- https://nptel.ac.in/courses/105/101/105101008/

Module-5	**L3 & L4**	**12 Hrs.**

Prerequisites: *Knowledge on intelligent transportation engineering*

Modern tool in transportation engineering: Geographical Information System – Global Positioning System – Intelligent Transportation Systems - Area Traffic Control – Automatic Toll Collection – Smart Cards – Collision Detection System.

Experimental learning:

- In-situ Automatic Toll Collection

Applications:

- In highways the travel time can be saved, helps in arriving the destination

Video link:

- https://nptel.ac.in/courses/105/101/105101008/

Course outcomes: On completion of the course, students would be able to	
CO1	Able to apply the flow theories to field situations such as toll booths, diversion measures etc.
CO2	Able to understand various problems enforced by bottleneck and shock waves on highway
CO3	Able to understand various car following theories
CO4	Able to apply the concepts of vehicle arrivals to field situations such as exit ramps, entry ramps etc by queuing theory
CO	Able to appreciate the application of GIS techniques in traffic engineering.

Reference Books:	
1.	Drew, D.R., Traffic Flow Theory and Control,McGrawHill.,1978TRB,
2.	Traffic Flow Theory - A Monograph, SR165,1975.
3.	Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication,2004

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	3	-	1	-	-	-	-	2	1
CO2	2	1	1	-	3	1	-	-	-	-	-	1
CO3	3	1	2	-	1	1	-	-	-	-	1	-
CO4	1	2	-	-	1	3	-	-	-	-	1	1
CO5	1	3	2	1	-	1	-	-	-	-	1	1

High-3, Medium-2, Low-1

Course Title	**RURAL ROADS**	Semester	II
Course Code	MVJ20CTE261	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 00 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

- Explain the concept and objective of providing low cost roads in developing country like India.
- Explain problems involved in the design of rural roads, preparation of rural road development plans and economic viability.
- Explain different types of surveys required for road alignment and road geometry with appropriate specifications.
- Introducing different materials used for construction and different types of construction procedures and equipment required for construction.
- Explain importance of road drainage, design of drainage and cross drainage structures with maintenance activities.

Module-1	**L3**	**12 Hrs.**

Pre requisites: Basics of Highway Engineering Planning

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

Video link / Additional online information:

- https://ruralroads.org/low-cost-road-surfaces/
- https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_policy/---invest/documents/publication/wcms_asist_9592.pdf
- http://www.pmgsy.nic.in/pmg931.asp
- https://shodhganga.inflibnet.ac.in/bitstream/10603/74747/10/10_chapter-3.pdf
- https://www.academia.edu/19122730/IRC_SP_020_Rural_Roads_Manual

Module-2	**L3**	**12 Hrs.**

Pre requisites: Basics of Highway Engineering Planning

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.

Video link / Additional online information:

- https://blogs.worldbank.org/transport/the-problem-with-rural-transport-is-that-it-is-rural-the-solution-is-in-branding
- http://onlinepubs.trb.org/Onlinepubs/trr/1991/1291vol1/1291-021.pdf

Module-3	**L3**	**12 Hrs.**

Pre requisites: Basics of Highway Geometric Design

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

Video link / Additional online information:

- https://nptel.ac.in/courses/105/101/105101087/
- http://pmgsy.nic.in/archives/nrrda/op4.asp
- https://www.academia.edu/19122730/IRC_SP_020_Rural_Roads_Manual

Module-4	**L3**	**12 Hrs.**

Pre requisites: Basics ofPavement materials Properties and Types of soil stabilization

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.

Video link / Additional online information:

- https://www.youtube.com/watch?v=2hHxF2-fK50
- https://nptel.ac.in/content/storage2/courses/105108075/module6/Lecture18.pdf
- https://nptel.ac.in/content/storage2/courses/105101005/downloads/Lec35.pdf
- https://www.diva-portal.org/smash/get/diva2:997144/FULLTEXT01.pdf

Module-5	**L3**	**12 Hrs.**

Pre requisites: Highway drainage

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. Video link / Additional online information: • https://www.academia.edu/19122730/IRC_SP_020_Rural_Roads_Manual

Course outcomes: On completion of the course, students would be able to	
CO1	Able to remember significance of low cost roads.
CO2	Capable of analyzing the problem associated with planning of low volume roads, preparing master plan of rural road network.
CO3	Capable of conducting surveys for rural road alignment and remembering specifications of various geometric features of road.
CO4	Capable of selecting and analyzing 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.

Reference Books:	
1.	IRC SP 20, 'Rural Roads Manual, Indian Roads Congress', New Delhi, 2002.
2.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', Nem Chand and Bros, Roorkee
3.	KRRDA Handbook for rural roads.
4.	HMSO, "Soil Mechanics for Road Engineers", Her Majesty's Stationary Office, London.
5.	Relevant IRC Codes & Publications
6.	International Road Maintenance Hand Book –Maintenance of Paved Roads France
7.	International Road Maintenance Hand Book –Maintenance of Unpaved Roads France

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	1	1	-	1
CO2	3	3	-	1	-	-	-	-	1	1	-	1
CO3	3	3	-	1	-	-	-	-	1	1	-	1
CO4	3	3	1	2	1	-	-	-	1	1	-	1
CO5	3	3	1	2	1	-	-	-	1	1	-	1

High-3, Medium-2, Low-1

Course Title	**TRANSPORTATION SYSTEMS**	Semester	II
Course Code	MVJ20CTE262	**CIE**	50
Total No. of Contact Hours	60 L : T : P :: 40 : 00 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective

- List the various types of roads and road patterns; explain the importance of 20 year road Development plans and current road projects in the country.
- Explain the factors affecting development of harbours and ports and elements in harbour and Port planning.
- Categorize various the national waterways in the country with their important characteristics.
- Explain the need of urban mass transportation in developing countries and compare the various Modes of urban mass transportation systems.

Module-1	**L3**	**12 Hrs.**

Introduction: Importance of transportation systems, Different modes, characteristics, their integration and comparison Highway systems – Road type and classification, road patterns, phasing road development in India, salient features of 3rd and 4th twenty year road development plans, Present scenario of road development in India and in Karnataka.

Video link / Additional online information:

- https://nptel.ac.in/courses/105101087/
- https://pib.gov.in/newsite/PrintRelease.aspx?relid=91384
- http://pmgsy.nic.in/downloads/vision2025.pdf
- https://kship.in/en/project_past_works.aspx

Module-2	**L3**	**12 Hrs.**

Railways systems:– Role of railways in transportation, Advantages of railways, Indian railways, classification, present scenario of railway development in India, Modernization of railways, development of high and super high speed railways.

Video link / Additional online information:

- https://youtu.be/37WMS483T7Y

- https://nptel.ac.in/courses/105107123/

Module-3	L3	12 Hrs.

Airports :.Overview of air transportation, Role of FAA and ICAO, air transport in India, types of airports, Heliports, STOL ports, complexities in airport planning, elements of airport planning, airport master plan, environmental impact.

Video link / Additional online information:

- https://youtu.be/WUq3uN4MDms

Module-4	L3	12 Hrs.

Harbours and Ports : Development of harbours and ports in India , characteristics, factors constraining development, elements of harbour and port planning, role of harbours and ports in transportation, National waterways, characteristics.

Video link / Additional online information:

- https://www.youtube.com/watch?v=3YY9FUVtG-4
- https://www.youtube.com/watch?v=gT0rAkmNuD8

Module-5	L3	12 Hrs.

Urban transportation systems: Importance of collective transportation v/s individual transportation, freight transportation, Physical system components of urban transportation, Overview of Mass rapid transit, Light rail transit, Personal rapid transit, guided way systems, Para transit systems, Mono rail, bus rapid transit systems

Video link / Additional online information:

- https://youtu.be/YAEyLOCU-8I
- https://nptel.ac.in/courses/105/106/105106058/

Course outcomes: On completion of the course, students would be able to

CO1	List, explain and compare the various modes of transportation with their relative merits and Demerits.
CO2	Classify the various types of roads and road patterns, list the salient features of 20 year road Development plans and discuss on current road projects in the country.
CO3	List and discuss on factors affecting development of harbours and ports and explain on elements in harbour and port planning.

CO4	List the various the national waterways in the country and explain their important characteristics.
CO5	Explain the need of urban mass transportation in developing countries and compare the various modes of urban mass transportation systems.

Reference Books:	
1.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', Nem ChandandBros, Roorkee
2.	S.C.Saxena and S.P.Arora "A text book of Railway Engineering", Dhanpat Rai publications
3.	Alan Black, Urban Mass Transportation Planning, McGraw-Hill, 1995.
4.	Vukan R. Vuchic, Urban Transit Systems and Technology, Wiley and Son, New York, 2005

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	-	1	-	-	1	2	-	1
CO2	3	1	-	1	-	-	1	-	1	1	-	1
CO3	3	3	-	1	-	-	-	-	1	1	-	1
CO4	3	3	3	2	1	-	2	-	1	1	1	1
CO5	3	3	1	2	1	-	-	1	1	1	-	1

High-3, Medium-2, Low-1

Course Title	**REMOTE SENSING AND GIS IN ENGINEERING**	Semester	II
Course Code	MVJ19CTE263	**CIE**	50
Total No. of Contact Hours	60 L: T : P :: 40 : 0 : 20	**SEE**	50
No. of Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hours

Course objective is to:

- Understand the basic concepts of remote sensing.
- Analyse satellite imagery and extract the required units.
- Extract the GIS data and prepare the thematic maps
- Use the thematic maps for various applications.

Module-1	**L3 & L4**	**12 Hrs.**

Introduction to Remote Sensing: Definition - History & Concepts - Electromagnetic Radiation(Source,ModeofEnergytransfer,RadiationPrinciples,Blackbodyradiation); **ElectroMagneticRadiation(EMR):**EMRSpectrum-EMRInteractionwithAtmosphere (Absorption, Scattering & Atmospheric windows) - EMR Interaction with Earth surface (Absorption & reflection) - Spectral Response pattern - Energy budgeting in Remote Sensing.

Laboratory Sessions/ Experimental learning:

- Introduction to Working Principles of software
- Arial photograph interpretation

Applications:

- Provides Basic knowledge of Geographical Information Systems

Module-2	**L3 & L4**	**12 Hrs.**

Sensors and Platforms: Resolutions (Spectral, Spatial, Temporal, Radiometric) –Platforms Sensors - Scanning & Orbiting Mechanism of Satellites and DataAcquisition.OpticalRemote Sensing: Basic concepts -Optical sensorsandscanners. **Thermal & Microwave Remote Sensing**: Thermal Remote Sensing: Basicconcepts-Thermal sensors & scanners - Thermal Inertia. Microwave Remote Sensing: Basicconcepts Microwave sensors and Radiometers - Geometric characters - Radargrammetry(SLAR/SAR) - LIDAR -Hyper spectral Remote Sensing:basicconcepts

Laboratory Sessions/ Experimental learning:

- Analog to Digital Conversion – Scanning methods
- Digital database creation – Point features, Line features, Polygon features

Applications:

- Teaching knowledge of creation of different shape files

Module-3	L3 & L4	12 Hrs.

RemoteSensingSatellites: LANDSAT Series-IRS Series-IRS-Pseries-Cartosat-Spot Series - ASTER, MODIS - IKONOS - QUICKBIRD - ORBVIEW -ERS -Meteorological Satellites -Shuttle Mission - Developments of Remote Sensing in India - Future Remote SensingMissions

Laboratory Sessions/ Experimental learning:

- Data Editing-Removal of errors – Overshoot, Undershoot, Snapping
- Data Collection and Integration, Non-spatial data attachment working with tables

Applications:

- Provides knowledge on accesses of Digital image processing

Video link / Additional online information:

- https://nptel.ac.in/courses/105103193/

Module-4	L3 & L4	12 Hrs.

Introduction to Geographical Information System (GIS): Definition - Usefulness of GIS - Components of GIS - Computer Hardware, Software Modules and Organizational Context of GIS. **Data Structure:** Data Structure in GIS - Types of Data (Points, Lines and Polygons) - Data Base Structures (Raster Data Structures and Vector data Structures) - Data Conversion (Vector to Raster and Raster to Vector)

Laboratory Sessions/ Experimental learning:

- Dissolving and Merging
- Clipping, Intersection and Union

Applications:

- Provides knowledge on accesses of Base Map Creation

Module-5	L3 & L4	12 Hrs.

Integrated Applications of Remote sensing and GIS: Applications in Land use Land cover analysis, change detection, Water Resources, Urban Planning, Environmental Planning, Natural Resource Management and Traffic Management. Location Based Services and its Applications

Laboratory Sessions/ Experimental learning:

- Point Data collection using GPS with different datum
- Line data collection using GPS and measurements

Applications:

- Gives knowledge of incorporation of GPS and GIS

Video link / Additional online information:

- https://nptel.ac.in/courses/121107009/

Course outcomes:	
CO1	Collect data and delineate various elements from the satellite imagery using their spectral signature
CO2	Analyse different features of ground information to create raster or vector data.
CO3	Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines.
CO4	Perform digital classification and create different thematic maps for solving specific problems
CO5	Make decision based on the GIS analysis on thematic maps.

Reference Books:	
1.	Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
2.	John R. Jensen, "Remote sensing of the environment" , An earth resources perspective – 2nd edition – by Pearson Education 2007
3.	Anji Reddy M., "Remote sensing and Geographical information system", B.S. Publications 2008
4	Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004
5	S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	2	1	-	2	1
CO2	2	3	-	-	-	-	-	2	1	-	2	2
CO3	3	2	2	2	2	1	2	3	2	2	2	2
CO4	3	2	2	2	3	2	2	2	2	3	3	3
CO5	3	3	3	3	3	2	3	2	2	3	3	3

High-3, Medium-2, Low-1

Course Title	**INFRASTRUCTURE MANAGEMENT & ENVIRONMENTAL IMPACT ASSESSMENT OF TRANSPORTATION**	Semester	III
Course Code	MVJ20CTE264	**CIE**	50
Total Contact Hours	60 L: T : P :: 40 : 00 : 20	**SEE**	50
Contact Hours/week	3	**Total**	100
Credits	3	**Exam. Duration**	3 Hrs

Course objective is to:

- Discuss the need of Infrastructure Management in planning and maintaining the Infrastructures
- Discuss the performance of Infrastructures, causes of failure, rating methods
- Formulate the development and application of models for Infrastructure management
- Discuss the need of application of methods of prioritization and application of innovative methods.
- Explain the impacts of transportation related components on environment

Module-1	**L3**	**12 Hrs.**

Prerequisites: *Knowledge on development of infrastructure*

Introduction: The Challenge of Managing Infrastructure- Infrastructure and Society-Definition-Infrastructure Assets-Life Cycle Analysis-Infrastructure Crisis-Infrastructure Management- An integrated approach.

Experimental learning:

- In-situ evaluation of management in infrastructure

Applications:

- In managing the infrastructure

Video link:

- https://nptel.ac.in/courses/105/106/105106188/

Module-2	**L3 & L4**	**12 Hrs.**

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.

Experimental learning:

- Planning the life cycle analysis of infrastructure

Applications:

- In infrastructure management

Video link:

- https://nptel.ac.in/courses/105/106/105106115/

Module-3	L3	13 Hrs.

Prerequisites: *Knowledge on quality control on pavement*

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.

Experimental learning:

- In-situ quality control checks for the airport pavements

Applications:

- In airport and railways

Video link:

- https://nptel.ac.in/courses/105/106/105106115/

Module-4	L3	12 Hrs.

Prerequisites: Knowledge on preventing methods for environment.

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.

Laboratory Sessions/ Experimental learning:

- ·Collection of effects on environment through public hearing.

Applications:

- Able obtain different effects and control over environment.

Video Link:

- ·http://www.kspcb.gov.in/Acts_Rules.html

Module-5	L3	11 Hrs.

Prerequisites: Knowledge on basic impacts on environment pollution.

Introduction: 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.

Laboratory Sessions/ Experimental learning:

- Documentation on EIA guidelines.

Applications:

- Able get a knowledge of rules and regulations of EIA.

Video Link:

- http://www.kspcb.gov.in/Acts_Rules.html

Course outcomes: On completion of the course, students would be able to	
CO1	Identify the factors influencing performance of Infrastructure
CO2	Carry out structural and functional evaluation of infrastructure
CO3	Explain the use of models for Infrastructure management
CO4	To assess the impacts of various development on environment
CO5	To describe the environmental imbalances, indicators and explain the concept of EIA

Reference Books:	
1.	Infrastructure Management: Design, Construction, Maintenance, Rehabilitation, Renovation, .W. Ronald Hudson, Ralph Haas and Waheed Uddin, McGraw Hill Co., 1997.
2.	Infrastructure Engineering and Management Neil S. Grigg, John Wiley and Sons.
3.	Modern Pavement Management,W. Ronald Hudson, Ralph Haas and Zeniswki, McGraw Hill and Co.
4.	Jain, R.K., Urban, L.V., Stracy, G.S., (1991), "Environmental Impact Analysis", Van Nostrand Reinhold Co., New York
5.	Rau, J.G. and Wooten, D.C., (1996), "Environmental Impact Assessment", McGraw Hill Pub.Co., New York

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	1	3	1	-	-	-	1	1
CO2	2	3	-	-	1	-	1	-	-	-	1	1
CO3	1	2	3	-	-	1	1	-	-	-	1	1
CO4	3	2	3	1	2	-	3	3	2	1	1	2
CO5	3	3	1	1	-	3	3	2	1	2	1	2

High-3, Medium-2, Low-1

Course Title	**REMOTE SENSING AND GIS IN ENGINEERING**	Semester	II
Course Code	MVJ20CTE265	**CIE**	50
Total No. of Contact Hours	40 L : T : P :: 40 : 00 : 0	**SEE**	50
No. of Contact Hours/week	03	**Total**	100
Credits	03	**Exam. Duration**	3 Hrs

Course objective is to:

- State the basic concepts of Remote Sensing.
- Identify the various Remote Sensing Platforms and its limitations
- Illustrate various international space programmes
- Brief various Geographical Information System (GIS) method
- Solve real time problem by the application of RS & GIS

Module-1	**L1 & L2**	8 Hrs.

Introduction to Remote Sensing:

Introduction: Introduction to Remote Sensing: Definition - History & Concepts - Electromagnetic Radiation (Source, Mode of Energy transfer, Radiation Principles, Black body radiation); Electro Magnetic Radiation (EMR): EMR Spectrum - EMR Interaction with Atmosphere (Absorption, Scattering & Atmospheric windows) - EMR Interaction with Earth surface (Absorption & reflection) - Spectral Response pattern - Energy budgeting in Remote Sensing.

Module-2	**L1 & L2**	8 Hrs.

Sensor and its characterstics:

Sensors and Platforms: Resolutions (Spectral, Spatial, Temporal, Radiometric) –Platforms Sensors - Scanning & Orbiting Mechanism of Satellites and Data Acquisition. Optical Remote Sensing: Basic concepts -Optical sensors and scanners. **Thermal & Microwave Remote Sensing**: Thermal Remote Sensing: Basic concepts-Thermal sensors & scanners - Thermal Inertia. Microwave Remote Sensing: Basic concepts Microwave sensors and Radiometers - Geometric characters – Radar grammetry (SLAR/SAR)- LIDAR -Hyper spectral Remote Sensing: basic concepts.

Module-3	**L1, L2**	8 Hrs.

Remote Sensing Satellite Programmes:

Remote Sensing Satellites: LANDSAT Series - IRS Series - IRS-P series -Cartosat - Spot Series - ASTER, MODIS - IKONOS - QUICKBIRD - ORBVIEW -ERS - Meteorological Satellites -Shuttle Mission - Developments of Remote Sensing in India - Future Remote Sensing Missions

Module-4	**L1, L2**	8 Hrs.

Introduction to Geographical Information System (GIS): Definition - Usefulness of GIS - Components of GIS - Computer Hardware, Software Modules and Organizational ContextofGIS. **Data Structure:** Data Structure in GIS - Types of Data (Points, Lines and Polygons) - Data Base Structures (Raster Data Structures and Vector data Structures) - Data Conversion (Vector to Raster and RastertoVector)

Module-5	**L1, L2**	8 Hrs.

Integrated Applications of Remote sensing and GIS: Applications in Land use Land cover analysis, change detection, Water Resources, Urban Planning, Environmental Planning, Natural Resource Management and Traffic Management. Location Based Services and its Applications	
Course outcomes: On completion of the course, students would be able to	
CO1	Collect data and delineate various elements from the satellite imagery using their spectral signature
CO2	Identified various Remote Sensing Platforms and its limitations
CO3	Restate and apply sustainability concepts in various space programmes
CO4	Analyse different features of ground information to create raster or vector data.
CO5	Perform digital classification and create different thematic maps for solving specific problems & Make decision based on the GIS analysis on thematic maps.

Scheme of Evaluation:

Details		**Marks**
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	**CIE(50)**	**30**
Quizzes		**2x2 = 4**
Activities / Experimentations related to courses		**8**
Mini Projects / Case Studies		**8**
Semester End Examination	**SEE (50)**	**50**
	Total	**100**

Reference Books:	
1.	Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
2.	John R. Jensen, "Remote sensing of the environment" , An earth resources perspective – 2nd edition – by Pearson Education 2007
3.	Anji Reddy M., "Remote sensing and Geographical information system", B.S. Publications 2008
4.	Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004
5.	S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	3	-	-	-	-	1	-	1	1
CO2	2	1	2	1	-	-	-	-	1	-	1	1
CO3	2	1	2	1	-	-	1	-	1	-	1	1
CO4	2	1	2	1	-	-	-	-	1	-	1	1
CO5	2	1	2	1	-	-	1	-	1	-	1	1

High-3, Medium-2, Low-1

Course Title	**TRANSPORTATION ENGINEEERING LAB**	Semester	II
Course Code	MVJ20CTEL27	**CIE**	50
Total No. of Contact Hours	01 Hour Tutorial (Instruction) 03 Hours Laboratory	**SEE**	50
No. of Contact Hours/week	04	**Total**	100
Credits	02	**Exam. Duration**	3 Hrs

Course objective is to:

- Illustrate application of soft computing techniques for solving transportation problems
- Illustrate the application of software for analyzing traffic survey datae, evaluation of Pavement functional and structural condition
- Explain and illustrate generation of models for transportation planning
- Introduce the methods of designing geometry of highways using computer software

Prerequisites: Material properties, theory of stress & strain

S.NO	**Experiments**	**L3,L4**
1	Experimenting Classified volume count survey	
2	Conducting Moving car method of speed and delay studies.	
3	Conducting Origin and destination studies	
4	Conducting Spot speed studies	
5	Conducting Highway capacity Estimation Studies and LoS study	
6	Conducting Pedestrian Survey	
7	Conducting Parking Survey.	
8	Conducting Road inventory and Pavement Condition Studies.	
9	Design of horizontal alignment, vertical alignment.	
10	Generating cross section and design of intersections.	
11	Design of flexible pavement using IRC-37:2012, Kenpave analysis	

Video Link:

- https://nptel.ac.in/courses/105101008/
- https://nptel.ac.in/courses/105105107/

Course outcomes:	
CO1	Examine and arrive at required output from traffic surveys
CO2	Identify the adequacy of the pavement performance- functional and structural, Analyse and generate models for transportation planning
CO3	Design the geometry of highways.
Reference Books:	
1.	User Manuals of various packages
2.	Relevant IRC publications
3.	C.S.Papacostas and P.D.Prevedouros "Transportation engineering & Planning", PHI learning
4.	Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', Nem Chandand Bros, Roorkee.
5.	Yang H Huang, `Design of Functional Pavements', McGraw Hill Book Co.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	2	1	1	2	2	1	2
CO2	3	3	3	3	1	1	1	1	2	1	2	2
CO3	3	3	3	3	2	1	-	1	2	1	2	2
CO4	3	2	3	2	-	1	1	1	2	1	1	2

High-3, Medium-2, Low-1