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	MVJ20CTE21	**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	MVJ20CTE05	**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

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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