Course Title	**PAVEMENT DESIGN AND ANALYSIS**	Semester	II
Course Code	MVJ19CTE21	**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, 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. 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	MVJ19CTE22	**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 in transportation
- Define the concept and components involved in economic evaluation
- Explain the various methods of economic analysis and ranking of alternatives
- Illustrate the method of economic evaluation for transportation projects

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 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	MVJ19CTE23	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. Signaling: 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, New Delhi
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	**THEORIES OF TRAFFIC FLOW**	Semester	II
Course Code	MVJ19CTE241	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	**GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES**	Semester	II
Course Code	MVJ19CTE242	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. Facilities for pedestrians and bicycles.

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	10 Hrs.

Prerequisites: Knowledge on importance of IRC recommendations

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

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	TRANSPORTATION SYSTEMS	Semester	II
Course Code	MVJ19CTE243	**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

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	**PAVEMENT MANAGEMENT SYSTEM**	Semester	II
Course Code	MVJ19CTE251	**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:

- Discuss the need of PMS in planning and maintaining the flexible pavements.
- Discuss the performance of pavements, causes of failure, rating methods.
- Formulate the development and application of models for pavement management.
- Discuss the need of application of methods of prioritization and application of innovative methods
- Discuss the application of Road Asset Management

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

Pre requisites: Concept of management, Highway engineering

Introduction: Definition -Components of Pavement Management Systems, Essential features. Pavement Management Levels and functions: Ideal PMS- Network and Project levels of PMS- Influence Levels- PMS Functions- Function of Pavement evaluation.

Laboratory Sessions/ Experimental learning:

- Field Surveys to identify the types of pavement failures

Applications:

- Pavement management schedule maintenance of good roads to keep them in good condition
- Understand the concept of ideal pavement management system that can apply in real engineering problems

Video link / Additional online information:

- https://nptel.ac.in/courses/105105107/
- https://nptel.ac.in/courses/105104098/

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

Pavement Performance: Serviceability Concept- Development of Serviceability Index-PSI-RCI-Roughness- Roughness Components- Evaluation-Equipment- Universal Roughness standard-

Techniques-IRI – Application of Roughness Data in Network level and Project Level.

Evaluation of Pavement Structural capacity: Basics- NDT and Analysis—Condition Surveys-Distress- Destructive Structural Analysis- Application in Network and Project Levels-Methodsand Equipment- Combined Measures of Pavement Quality-Concept-Methods of developing a combined index-limitations.

Laboratory Sessions/ Experimental learning:

- NDT tests for pavement evaluation
- Field Surveys to identify the roughness data

Applications:

- Understanding the present condition of pavement and future performance based on expected traffic value can be predicted
- Practical problems faced during the evaluation can be understood and feasible solutions can be expected taking into consideration in the real time problems

Video link / Additional online information:

- http://nptel.ac.in

Module-3	L3, L4	12 Hrs.

Pre requisites: Causes of pavement distress

Evaluation of Pavement Distress and Functional Aspects: Principles- Condition survey- Survey Methodology-Types of Distress-Examples-Equipment-Indexes-Applications of Distress data-Pavement Safety-Components –Evaluation-Basic Concepts of Skid resistance-Methods of measuring skid resistance- Effect of Time ,Traffic and Climate on Skid resistance. Establishing Criteria -Rehabilitation and Maintenance.

Laboratory Sessions/ Experimental learning:

- Field Surveys to identify the types of distress

Applications:

- Practical challenges and difficulties in conduction of pavement surveys and its possible outcomes
- Understand the basic concept of pavement distress and study of varies application of distress data

Video link / Additional online information:

- http://nptel.ac.in

Module-4	L3, L4	12 Hrs.

Expert Systems and Pavement Management: Implementation of Pavement Management Systems.

Laboratory Sessions/ Experimental learning:

- Bump Indicator for roughness survey

Applications:

- Pavement management system can help transportation departments to make cost-effective decisions

Video link / Additional online information:

- http://nptel.ac.in

Module-5	L3	12 Hrs.

Road Asset Management: Management, Data and Modelling, Planning Application

Laboratory Sessions/ Experimental learning:

- Use of SPSS software in pavement management
- Modeling methods

Applications:

- Computer technology has improved the detail and accuracy of road measurement technology
- Pavement management incorporates life cycle cost into a more systematic approach to minor and major road maintenance and reconstruction projects
- Application of road asset management in highway engineering problems

Video link / Additional online information:

- http://nptel.ac.in

Course outcomes: On completion of the course, students would be able to	
CO1	Identify the factors influencing performance of pavement.
CO2	Carry out structural and functional evaluation of pavements
CO3	Explain the use of models for pavement management.
CO4	Develop a framework for efficient pavement management system
CO5	To apply Road Asset Management

Reference Books:	
1.	Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co.1978.
2.	Ralph Haas, Ronald Hudson Zanieswki. 'Modern Pavement Management, Kreiger Publications, New York, 1992.
3.	PIARC Guidelines
4.	Proceedings of North American Conference on Managing Pavement, USA,2004.
5.	Proceedings of International Conference on Structural Design of Asphalt Pavements NCHRP, TRR and TRB Special Reports, USA,2006.

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

High-3, Medium-2, Low-1

Course Title	**TRANSPORTATION STRUCTURES**	Semester	II
Course Code	MVJ19CTE252	**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:

- Classify the various transportation structures, explain the principles of design methods and list the steps involved in the design of various transportation structures.
- Gain the knowledge of various loads acting on the bridge
- Gain the knowledge of sub-structure design criteria
- Discussed the design code of pre-stressed concrete bridges
- Identify the input parameters required for design of transportation structures and design and evaluate a transportation structures based on the data given.

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

Introduction: Principles of Planning of Elevated Rail Transit System, grade separation structures, pedestrian crossing and sub- ways.

Laboratory Sessions/ Experimental learning:

- Impact test on aggregates

Applications:

- Understanding the main principles of planning in structures
- Understand the basic information about structures

Video link / Additional online information:

- http://nptel.ac.in

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

Pre requisites: Loads on structures

Loads on Bridges: Dead loads, live loads, dynamic effects of vehicles, longitudinal forces, centrifugal forces, wind loads, earth quake forces, stream flow pressure, load combinations, design examples.

Laboratory Sessions/ Experimental learning:

- Dynamic loadings using loading frame test

Applications:

- Understand the major loads considered in the bridge design
- Understand the basic factor considered in bridge construction

Video link / Additional online information:

- http://nptel.ac.in

Module-3	L3	12Hrs.

Design of Bridge Slabs: Longitudinally reinforced deck slabs, transversely reinforced bridge slabs.

Sub-Structure Design: Foundation investigation, bearings, bridge pier design, and abutment design, Examples.

Laboratory Sessions/ Experimental learning:

- Bending and Deflection test

Applications:

- Understand the basic information about bridge construction
- Practical knowledge regarding the sub-structure design

Video link / Additional online information:

- http://nptel.ac.in

Module-4	L3	12Hrs.

Design of Reinforced Concrete Bridges: Design procedures for T- beam, box girder bridges design examples.

Laboratory Sessions/ Experimental learning:

- Direct tension testing
- Testing of structural elements of bridge structure

Applications:

- Understand the importance of bridge design process
- Practical problems faced in design procedure and understand the remedies

Video link / Additional online information:

- https://nptel.ac.in/courses/105/105/105105165/

Module-5	L3	12Hrs.

Design of Pre-stressed Concrete Bridges: Design code, design examples.

Segmental Box bridges: precast sections, criteria, design examples

Laboratory Sessions/ Experimental learning:

- Non-destructive load test
- Design of concrete bridges using software

Applications:

- Understand the design criteria for segmental box bridges
- Understand the specifications of pre-stressed concrete bridges

Video link / Additional online information:

- https://nptel.ac.in/courses/105/106/105106117/

Course outcomes: On completion of the course, students would be able to	
CO1	Decide the selection of transportation structures, list the factors affecting design of various transportation structures and generate the input parameters required for design.
CO2	Analyse and design various loads acting on the bridge
CO3	Analyse and design foundation for bridges
CO4	Summarize the design methodology and arrive at design values for various transportation structures.
CO5	Able to understand the behaviour of pre-stressed sections

Reference Books:	
1.	Raina,R.K, 'Principles of Design of RCC Bridges, Tata McGraw Hill,1999.
2.	Krishnaraju 'Bridge Engineering', UPD Publishers, New Delhi,2000.
3.	Conrad P. Heins and Richard A. Lawrie, `Design of Modern Concrete Highway Bridges, John Wiley and Sons, 1999.
4.	Baider Bakhtand Leslie, G.Jaeger,` Bridge Analysis Simplified, McGrawHill Book Co,1998.
5.	Johnson Victor, `Bridge Engineering', Oxford IBH, NewDelhi, 2000.

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

High-3, Medium-2, Low-1

Course Title	**APPLIED STATISTICS**	Semester	II
Course Code	MVJ19CTE253	**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 offit.
- 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 Simplexmethod-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.and Kapoor 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	**REMOTE SENSING AND GIS IN ENGINEERING**	Semester	II
Course Code	MVJ19CTE261	**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, 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.

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 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 **-** Radargrammetry (SLAR / SAR) - LIDAR **-**Hyper spectral Remote Sensing: basic concepts

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.

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

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	**SUSTAINABILITY CONCEPTS IN ENGINEERING**	Semester	II
Course Code	MVJ19CTE262	**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:

- Learn about the principles, indicators and general concept of sustainability.
- Apprehend the local, regional and global impacts of unsustainable designs, products and processes.
- Apply the sustainability concepts in engineering
- Know built environment frameworks and their use
- Understand how building and design is judged and valued by clients and stakeholders and how to implement sustainability.

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

Introduction: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.

Applications:

- Knowledge of the scope of the subject.
- Knowledge about dynamics of sustainable systems.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

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

Global Environmental Issue: Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste – sources, impacts of solid waste, Zero waste concept. Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS).

Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.

Laboratory Sessions/ Experimental learning:

- Pollution assessment tests for different areas and give remedies to control it.

Applications:

- Understanding the various environmental pollutions, its effects and how to overcome the global environmental issues.
- Getting an idea to improve urban infrastructure.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

Module-3	L3	12Hrs.

Sustainable Design:

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.

Laboratory Sessions/ Experimental learning:

- Conduct any sustainability event in the campus (ex: Technical talk, Documentary/film etc)

Applications:

- Knowledge about Sustainable design and green construction.
- Understanding the design of energy efficient building.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

Module-4	L3 & L4	10Hrs.

Clean Technology and Energy:

Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.

Laboratory Sessions/ Experimental learning:

- Industrial visit of any of the energy sources and make a report on it.

Applications:

- Understanding the various application of different energy sources

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

Module-5	L3	12 Hrs.

Green Engineering:

Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

Laboratory Sessions/ Experimental learning:

- Develop a sustainability project for a green campus

Applications:

- Understanding the concept of green engineering and how it is applicable for the sustainability in society.

Video link / Additional online information:

- https://nptel.ac.in/courses/127/105/127105018/
- https://nptel.ac.in/courses/107/103/107103081/

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

CO1	Learn the sustainability concepts, understand the role and responsibility of engineers in sustainable development
CO2	Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits
CO3	Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines
CO4	Application of engineering knowledge in utilization of natural resources for the production materials.
CO5	Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society

Reference Books:	
1.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2.	Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage Learning
3.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4.	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication,1998
5.	Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers
6.	Daniel A. Vallero and Chris Brasier, " Sustainable Design: The Science of Sustainability and Green Engineering", Wiley-Blackwell

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

High-3, Medium-2, Low-1

Course Title	**OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT**	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 Hrs

Course objective is to:

- To understand the concepts of global scenario of Health & safety.

- Students should be able to analyses and solve basic ergonomical issues.

- To be efficient in the operation of industrial hygiene equipment.

- To illustrate the importance and need of Fire & Safety.

- Students should be able to know the basics of fire and its classification.

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

Prerequisites: Basic knowledge about various types of hazards

Physical and Chemical Hazards: Recognition, Evaluation and Control of Physical Hazards- Noise and Vibration - Effects and Control

Measures- Thermal Stress - Parameter Control, Radiation - Types - Source - Effect and Control Illumination & Lighting. Recognition, Evaluation and Control of Chemical Hazards- Types - Dust-Fumes -Mist -Vapor-Fog etc., Air Contaminants- Evaluation - Types of Sampling-Air Sampling System-Method Analysis-Control Measures.

Laboratory Sessions/ Experimental learning:

- Measurement of Sound/Noise Level at Various Location and Compare it with Standard Values Permissible for Exposure.

- Determination of SPM and RSPM Present in Working Atmosphere during the Working Period with the help of Respirable Dust Sampler.

- Determination of SPM and Oxides of Sulphur and Nitrogen from the Stack/Chimney using Stack Monitoring kit.

- Determination of pH, TDS, Temperature, DO of water with the help of Multiparameter Monitoring Instrument

Applications:

- Documentation of the report on noise level in the working environment

- Documentation of report on SPM and RSPM present in air

- Preparation of water quality analysis report

Video link / Additional online information:

- Hazard terminologies, hazard identification, methods, risk determination, https://www.youtube.com/watch?v=JkTbfVkKGCI#action=share

- Hazard classification and assessment, evaluation, control, https://nptel.ac.in/courses/114106017/

- Hazard analysis necessity, hazard evaluation and control https://www.youtube.com/watch?v=WMPodFzWsSs

Module-2	L3	12 Hrs.

Prerequisites: Basic idea about ergonomical issues

Occupational Health: Concept and Spectrum of Health-Functional Units and Activities of Occupational Health Services-Occupational and Work-related Disease-Levels of Prevention of Diseases - Notifiable Occupational Diseases such as Silicosis- Asbestosis- Pneumoconiosis--Aluminosis and Anthrax. Lead-Nickel, Chromium and Manganese Toxicity-Gas Poisoning (such as CO, Ammonia, Coal Dust etc.,) their effects and Prevention- Cardio Pulmonary Resuscitation-Audiology-Hearing Conservation Programme-Effects of Ultra Violet Radiation and Infrared Radiation on Human Systems Industrial Toxicology-Local and Systemic and Chronic Effects Temporary and Cumulative Effects- Carcinogens Entry into Human System Ergonomics, Personnel Protective Equipment, Personnel Monitoring.

Laboratory Sessions/ Experimental learning:

- A study on analysis of occupational health hazards in a working place

- A study on health monitoring programs out in industries

Applications:

- Preparation of a detailed report on identification of occupational health issues of workers in a working place (manufacturing/service-based industries).

- Preparation of a detailed report on identification of occupational health issues of workers in a corporate sector

Video link / Additional online information**:**

- Occupational health, safety concern, integrity of the system, risk assessment, **https://nptel.ac.in/courses/110105094/**

- Risk assessment: process, identification, individual and societal,

https://www.youtube.com/watch?v=DxZ2rX0AtcM#action=share

- A manual for primary health care workers, occupational related diseases, disease detection, occupational ergonomics, accident prevention, psychological factors, effects, **https://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf**

Module-3	L3	12 Hrs.

Prerequisites: Basic knowledge about ergonomical issues

Personal Hygiene and First Aid: Hygiene Concepts-Correct and Clean Dresses-Clean Body - Washing - Good Habits-Oral and Stomach Hygiene-Cleaning - Compressed Air and Degreasing Agents-Long Hair and Nails and Torn and loosely Hanging Clothes-Smoking - Lavatories Maintenance- Living in Unhygienic Areas. First aid concept- -First Aid Boxes-Legal Requirements, Industrial Hygiene, Medical Surveillance, Medical Surveillance Program Development, Recommended Medical Programme, Emergency Treatment, Non-Emergency Treatment, Exposures to Hazardous Materials.

Laboratory Sessions/ Experimental learning:

- Demonstration and training on the usage of personal protective equipments, breathing apparatus, Emergency evacuation drill etc.
- First Aid training and demonstration

Applications:

- Documentation of the report on first aid training and demonstration
- Awareness program on the utilization of the facilities provided to maintain the health of workers in working places

Video link / Additional online information:

- Importance of first aid, injuries, fractures, poisoning, prevention of occupational diseases and accidents, health education, occupational health for women and children https://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf
- Safety assurance and assessment, Health, Safety and Environment (HSE), hazardous waste release procedure, hazard identification plan, organising safety, https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/114106039/lec9.pdf
- Human body health hygiene, safety and first aid, biology reaction, https://www.youtube.com/watch?v=MeQuR6N1YQ4
- Employee welfare, welfare measures inside the working place, workers health services https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/122105020/lec10.pdf

- First aid training, https://www.youtube.com/watch?v=qahukkDYFbk
- First aid - emergency medical services, injuries, first aid kit, https://www.youtube.com/watch?v=Q62UwEPPnrg

Module-4	L3	12 Hrs.

Prerequisites: Importance and need of Fire & Safety

Fire safety: Sources of Ignition- Principles of Fire Extinguishing, Various Classes of Fires, types of Fire Extinguishers, Fire Stoppers, Hydrant Pipes, Hoses, Monitors, Fire Watchers, Maintenance of Fire Trucks, Foam Generators, Escape from Fire, Rescue Operations, Fire Drills, Notice, First Aid for burns

Industrial fire Protection System , Sprinkler-Hydrants -Stand Pipes, Special Fire Suppression Systems (Deluge and Emulsifier), Selection Criteria of the above Installations, Reliability, Maintenance , Evaluation and Standards, Alarm and Detection Systems, Other Suppression Systems (CO2 System - Foam System , Dry Chemical Powder (DCP) System, Halon System), Need For Halon Replacement, Smoke Venting, Portable Extinguishers, Flammable Liquids, Tank Farms, Indices of Inflammability, Fire Fighting Systems

Fire Load, Fire Resistant Material and Fire Testing, Structural Fire Protection, Structural Integrity, Exits and Egress, Fire Certificates, Fire Safety requirements for high-rise Buildings

Laboratory Sessions/ Experimental learning:

- Laying out and Rolling of fire hoses, Priming of water from fire tenders using suction hose, static tank Hydrant fire drills, Site visit.
- Identification rehearsals of Portable extinguishers, Filling of DCP powder in Portable Extinguisher and wearing Protective clothing, Mock drills

Applications:

- A detailed report on classification of fire extinguishers
- Documentation on fire prevention solutions, fire detection systems, emergency lighting, means of escape for both onshore and offshore premises, and detailed individual evacuation plans.

Video link / Additional online information:

- Fire protection: basic concept, fire resistance, introduction of combustion process, https://nptel.ac.in/courses/105102176/
- Fire protection, services and maintenance, management of building, https://www.youtube.com/watch?v=n6HAyxdup_U#action=share

- Fire: Effect of enclosure, fire load, standard fire, fire resistance, https://www.youtube.com/watch?v=krnmHKZ87Wg#action=share
- Fire safety: urban planning, internal planning, occupancy, zoning, https://www.youtube.com/watch?v=eAKTwc3_ixE#action=share
- Fire safety: escape and refuge, planning, exit, https://www.youtube.com/watch?v=O6CYQt9vi_Y#action=share
- Fire safety: Internal planning, detection and suppression, flame spread, http://www.youtube.com/watch?v=e3Orj5XDj2M#action=share

Module-5	L3	12 Hrs.

Prerequisites: Basic Knowledge of Industrial Safety

Safety Policies, OSHAS and Radiation control: Importance of Safety, health and environment. Health safety and environmental policy, fundamentals of safety, classification of accidents, Managements responsibility, objectives of safety management, National safety council, Employees state insurance act 1948, approaches to prevent accidents, principles of safety management, safety organization, safety auditing, maintenance of safety, measurements of safety performance, industrial noise and noise control, Industrial Psychology, Industrial accidents and prevention. Introduction to OSHAS 18001 AND OSHA.

Radiation Shielding - Radiation Dose - Dose Measurements - Units of Exposure- Exposure Limits-Barriers for Control of Radioactivity Release, Control of Radiation Exposure to Plant Personnel, Health Physics Surveillance - Waste Management and Disposal Practices – Environmental, Releases.

Laboratory Sessions/ Experimental learning:
- A performance study on responsibility of management for safety in industries, safe guarding the workers
- A study on OSHAS by considering a case-study

Applications:
- Documentation on an effective safety management in a manufacturing industry from workers health point of view.
- Detailed report on OSHAS certification

Video link / Additional online information:
- OSHAS laboratory safety guidance: Types of hazards, safety hazards, laboratory standards, https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf
- OSHAS 18001: Integrity:- machines, processes, human system, example of an heat metal

transfer, safety and health philosophy of an organization, https://nptel.ac.in/courses/110105094/

- OSHAS 18001: Part I lecture, https://www.youtube.com/watch?v=Rr-xFmErOTk#action=share

- OSHAS 18001: Part II lecture, safety and health philosophy, of an organization, https://www.youtube.com/watch?v=n7oUOUCIblg#action=share

- OSHAS 18001: Part III lecture, case-study of a steel plant, behavioral safety and process safety, https://www.youtube.com/watch?v=8GmIoIlsJ7w#action=share

Course outcomes: On completion of the course, students would be able to	
CO1	Gains the knowledge about the various types of hazards and their control measures
CO2	Gains the knowledge about the occupational health issues
CO3	Able to analyse and solve occupational health issues
CO4	Able to know the basics of fire and its precautions, active and passive fire protection system in building or other industries/ premises.
CO5	To render the concept of safety analysis and confined space

Reference Books:	
1.	Risk assessment- A Practical Guide, 1993, Institution of Occupational Safety and Health, United Kingdom
2.	Hand Book Of Fire Technology By: R.S. Gupta, Orient Longman Publishers, Second Edition, 2005
3.	Hand Book Of Fire And Explosion Protection Engineering By: Dennis P Nolan, Crest Publishing House, First Edition, 2007
4.	Fire Protection And PreventionBy: Brendra Mohan San, Publishers: UBS Publishers & Distributors Pvt Ltd., Edition: First Edition, Year of Publication: 2008
5.	Industrial safety management By: L.M. Deshmukh, Publishers: Tata Megraw Hill ,New Delhi, Year: 2006,First Edition
6.	Industrial safety health and environment Management system By: R.K. Jain & Sunil S. Rao, Publishers: Khanna Publishers, Year: 2008, Edition: Second
7.	A Handbook on health, Safety and Environment, SC Bhatia
8.	S Rao, H L Saluja- Electrical Safety, Fire Safety Engineering and Safety Management

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

High-3, Medium-2, Low-1

Course Title	**TRANSPORTATION ENGINEEERING LAB**	Semester	II
Course Code	MVJ19CTEL27	**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