MVJ College of Engineering, Bengaluru
(An Autonomous Institute)
Affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Recognised by UGC with 2(f) & 12 (B), Accredited by NBA & NAAC

Department of CIVIL ENGINEERING

About Department

The Department offers a UG programme, two PG programmes (M.Tech in Structural Engineering and Transportation Engineering) which are approved by AICTE and affiliated to Visvesvaraya Technological University, Belagavi , recognized by Government of Karnataka. Since its inception in 1982, faculty with good blend of experience in Research, Industry and Academia are actively involved in research and academic activities (the h-index of the department is 7). The department has established state of art research and academic laboratories. Apart from curriculum, students are actively involved in research activities, in-house projects and internships. They also take part in inter collegiate activities conducted by other colleges. "SHRUSTI" a departmental club organizes technical events to encourage students to showcase their talents in co-curricular activities.

VISION:

To prepare skilled professionals in Civil engineering technology, who move towards making a more sustainable and socially responsible future.

MISSION:

- **Optimal environment for Lifelong learning:** To create Civil engineers by creating and maintaining an optimal teaching and learning environment in which faculty grow professionally and students receive unsurpassed knowledge skills, insights and the tools for lifelong learning in their respective disciplines.
- **Enhancing classroom Approaches:** To provide ample classroom teaching and practical sessions and enable the students to learn technology effectively.
- **Periodic interactions with industry:** To expose the students to latest technology and industrial practices through industrial interactions.
- **Value based Education:** To make socially responsible professionals through value based education.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1: Professional development: They will be successful professional working in government or Private organizations as Civil Engineers.

PEO2: Lifelong learning: Graduates will innovate and follow sustainable practices in Civil Engineering.

PEO3: Higher Education: Graduates will pursue higher education that is adaptive to changing needs of profession in community.

PROGRAM SPECIFIC OBJECTIVES

PSO1: Analysis and Design: The program demonstrates the analysis and design of Structural, Geo technical, Transportation and Environmental Engineering system.

PSO2: Modern Tools: The program demonstrates modern computational methods applied to Civil Engineering.

PROGRAMME OUTCOMES

PO1: Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and life – long learning in the broadcast context of technological change.

MVJ COLLEGE OF ENGINEERING
Department of Transportation Engineering
Scheme of Teaching and Examination 2019-20
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2019-20)

I SEMESTER M.Tech

S No	Course and Course code		Course Title	Teaching Department	Teaching hours/week			Total Marks			
					Theory Lecture	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	Credits
					L	P					
1	PCC	MVJ19CTE11	Traffic Engineering	CV	4	0	4	50	50	100	4
2	PCC	MVJ19CTE12	Pavement Materials	CV	4	0	4	50	50	100	4
3	PCC	MVJ19CTE13	Applied Soil Mechanics and Ground Improvement Techniques	CV	4	0	4	50	50	100	4
4	PCC	MVJ19CTE14	Urban Transport Planning	CV	4	0	4	50	50	100	4
5	PCC	MVJ19IPR15	Research Methodology and IPR	CV	2	0	2	50	50	100	2
6	PCC	MVJ19CTEL16	Highway Materials Testing Lab	CV	1	2	3	50	50	100	2
7	PCC	MVJ19CTEL17	Concrete and Geo technical engineering Lab	CV	1	2	3	50	50	100	2
Total					**20**	**4**	**24**	**400**	**400**	**700**	**22**
Note: PCC: Professional Core.											

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II SEMESTER M.Tech

S No	Course and Course code		Course Title	Teaching Department	Teaching hours/week			Teaching hours/week			
					TheortTheoryy Lecture	Practical/Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	Credits
					L	P					
1	PCC	MVJ19CTE21	Pavement Design and Analysis	CV	4	0	4	50	50	100	4
2	PCC	MVJ19CTE22	Transportation Economics And Evaluation	CV	4	0	4	50	50	100	4
3	PCC	MVJ19CTE23	Railways and Airways	CV	4	0	4	50	50	100	4
4	PEC	MVJ19CTE24X	**Professional Elective-1**	CV	3	0	3	50	50	100	3
5	PEC	MVJ19CTE25X	**Professional Elective-2**	CV	3	0	3	50	50	100	3
6	OEC	MVJ19CTE26X	**Open Elective**	XX	3	0	3	50	50	100	3
7	PCC	MVJ19CTEL27	Transportation Engineering Lab	CV	1	2	3	50	50	100	2
8	PCC	MVJ19CTEP28	Mini Project	CV	0	2		100		100	2
				Total	**21**	**6**	**18**	**450**	**360**	**800**	**25**

Note: PCC: Professional Core, PEC: Professional Elective, OEC: Professional Open Elective.

Note:
1. Mini Project: All the students shall have to Perform Mini Project in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Mini Project work..Mini Project shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the Mini Project shall be declared as failed and have to complete during the subsequent University examination after satisfying the Project requirements.

Professional Elective-I		**Professional Elective-II**		**Open Elective**	
MVJ19CTE241	Theories of traffic flow	MVJ19CTE251	Pavement Management System	MVJ19CTE261	Remote Sensing and GIS in Engineering
MVJ19CTE242	Geometric Design of Transportation facilities	MVJ19CTE252	Transportation Structures	MVJ19CTE262	Sustainable Concepts in Civil Engineering
MVJ19CTE243	Transportation Systems	MVJ19CTE253	Applied Statistics	MVJ19CTE263	Occupational Health and Safety

Professional Elective-III		Professional Elective-IV	
MVJ19CTE321	Road Safety and Management	MVJ19CTE331	Rural Roads
MVJ19CTE322	Intelligent Transportation Systems	MVJ19CTE332	Environmental Impact Assessment of Transportation Projects
MVJ19CTE323	Infrastructure Management	MVJ19CTE333	Pavement Evaluation And Management

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III SEMESTER M.Tech

S No	Course and Course code		Course Title	Teaching Department	Teaching hours/week			Teaching hours/week			Credits
					Theory Lecture	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
					L	P					
1	PCC	MVJ19CTE31	Pavement Construction Technology	CV	4	0	3	50	50	100	4
2	PEC	MVJ19CTE32X	**Professional Elective-3**	CV	4	0	3	50	50	100	3
3	PEC	MVJ19CTE33X	**Professional Elective-4**	CV	4	0	3	50	50	100	3
4	PCC	MVJ19CTE34	Technical Seminar	CV	0	2		100		100	2
5	Internship	MVJ19CTE35	Internship	CV	(Completed during the intervening vacation of II and III semesters and)		3	40	60	100	6
6	Project	MVJ19CTEP36	Evaluation of Project Phase-1	CV		2		100		100	2
				Total	**18**	**6**	**18**	**340**	**360**	**700**	**20**

Note: PCC: Professional Core, PEC: Professional Elective.

1. Project Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.SEE (University examination) shall be as per the University norms.
2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation for 10 Weeks. Those, who have not pursued /completed the internship shall be declared as failed and have to complete during subsequent
University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.
3. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.
The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

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IV SEMESTER M.Tech

S No	Course and Course code		Course Title	Teaching Department	Teaching hours/week			Teaching hours/week				Credits
					Theory Lecture	Tutorial	Practical/Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
					L	T	P					
1	Project	MVJ19CTEP41	Project Work Phase -2	CV	4	0	0		50	50	100	19
				Total	4	0	0		**50**	**50**	**100**	**19**

Note: PCC: Professional Core, PEC: Professional Elective.

Note:

1. Project Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase-2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25. SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

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TRAFFIC ENGINEERING

Course Code	MVJ19CTE11	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	50	**Total**	100
Credits	**04**	**Exam. Duration**	3 Hrs

Course Objectives

Course Objectives: This course will enable students 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.

Modules	RBT Level	Hrs.
Module-1		
Introduction: 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	**L1, L2,L3**	**10 Hrs**
Module-2		
Traffic Engineering Studies and Analysis: Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, methods of traffic study, equipment, data collection, analysis and interpretation (including case studies) of (i) Spot speed (ii) Speed and delay studies (iii) Volume studies (iv) Origin – Destination survey (v) Parking studies vi) Accident studies.(As per relevant IRC formats)	**L1, L2,L3**	**11 Hrs**
Module-3		
Design of Traffic Engineering Facilities : Control of Traffic Movements through Time Sharing and Space Sharing Concepts; Channelizing Islands, T, Y, Skewed, Staggered,	**L1, L2,L3**	**09 Hrs**

Roundabout, Mini-round about and other forms of at-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections.		
Module-4		
Traffic Control Devices: Traffic signs, markings, islands and signals. Different methods of signal design; redesign of existing signal including case studies, VMS, Road Lighting. Analysis of conflict points for all types of junctions and conditions.	**L1, L2,L3**	**09 Hrs**
Module-5		
Traffic safety and management: Road accidents, causes, effects and prevention, promotion and integration of public transport, promotion of non-motorized transport, area traffic management system, traffic system management(TSM), travel demand management(TDM), Congestion and parking pricing.	**L1, L2,L3**	**11 Hrs**

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

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 capable of understanding traffic movements and designing islands, intersections and road lightings

CO3: Capable of designing signals, redesigning the existing signals.

CO4: Able to remember traffic regulations, impact of noise pollution, air pollution and the method of controlling them.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. Kadiyali, L.R. `*Traffic Engineering and Transport Planning'*, Khanna Publishers.
2. Drew, D.R. `*Traffic Flow Theory and Control*', McGraw Hill Book Co.
3. IRC and IS Publications.
4. Institute of Transportation Engineers, `*Manual of Transportation Engineering Studies',* Prentice Hall
5. Khanna and Justo, '*Text book of Highway Engineering'*, Nemchand Brothers, Roorkee,
6. 2000.
7. Papacostas, C.A., *Fundamentals of Transportation Engineering'*, Prentice-Hall of India Private Limited, New Delhi.2000.

Web Link and Video Lectures:

1. http://nptel.ac.in

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PAVEMENT MATERIALS

Course Code	MVJ19CTE12	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	50	**Total**	100
Credits	**04**	**Exam. Duration**	3 Hrs

Course Objectives

This course will enable students to:

- Explain the different types, properties and tests on soil subgrade
- Explain the properties of aggregates and different test procedures and specifications
- Explain the origin, properties, constituents and preparation of bitumen, tar, cutback bitumen and emulsions.
- Illustrate the bituminous mix design method.
- Explain in detail about HMA, WMA, CMA Explain types of cement, tests on cement, types of concrete, fillers and sealers

Modules	RBT Level	Hrs.
Module-1		
Soil: Characterization: Properties of subgrade layers; different types of soils, Soil Classification; Index and other basic properties of soil; A critical look at the different laboratory and in - situ procedures for evaluating the mechanical properties of soils viz. SPT, CPT, CBR, Plate Load test, Field compaction and control.	**L1, L2,L3**	**08 Hrs**
Module-2		
Aggregates: Origin, 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.	**L1, L2,L3**	**10 Hrs**

Module-3		
Bitumen : 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.	**L1, L2,L3**	**10 Hrs**
Module-4		
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, Modified binders, HMA, WMA, CMA	**L1, L2,L3**	**12 Hrs**
Module-5		
Cement and Concrete : Types of cements and basic cement properties, Quality tests on cement; Tests on cement concrete including compressive strength, flexural strength, modulus of elasticity and fatigue properties; Introduction to advanced concretes like self-compacted concrete, Light weight concrete, Roller Compacted Concrete for pavement application; Joint fillers and sealers for Jointed Plain Cement Concrete Pavements and their characterization.	**L1, L2,L3**	**10 Hrs**

Course outcomes

After the completion of the course students should be

CO1: Able to gain knowledge about soil, properties and its behaviour.

CO2: Able to gain knowledge about aggregates, properties and tests.

CO3: Capable of doing mix design for different layers of pavement.

CO4: Able to gain knowledge about cement, tests, joints.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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"*- (2^{nd}Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.
5. Relevant *IRC* and *MoRTH* Publications.

Web Link and Video Lectures:

1. http://nptel.ac.in

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APPLIED SOIL MECHANICS AND GROUND IMPROVEMENT TECHNIQUES

Course Code	MVJ19CTE13	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	50	**Total**	100
Credits	**04**	**Exam. Duration**	3 Hrs

Course Objectives

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

Modules	RBT Level	Hrs.
Module-1		
Introduction To Soil Mechanics And Site Investigation: Soil Mechanics applications to Highway Engineering. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems on these. **Site Investigation:** Introduction, Planning exploration programmes, Types of Exploration, Location and depth of Borings, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods	**L1, L2,L3**	**10 Hrs**
Module-2		
Shear Strength Of Soil : Introduction, Importance, Measurements, shear strength of clay and Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus	**L1, L2,L3**	**10 Hrs**

Module-3		
Ground Improvement: Definition, Objectives of ground improvement, Classification of ground Improvement techniques Soil Compaction- Effect of grain size distribution on compaction for various soil types like lateritic soil, coarse-grained soil and micaceous soil. The Effects of compaction on engineering behavior like compressibility, swelling and shrinkage, permeability, relative density, liquefaction potential. Field compaction – static, dynamic, impact and vibratory type. Shallow and deep compaction, Dynamic Compaction, Vibrofloatation Case study: Dynamic compaction , Vibrofloatation	**L1, L2,L3**	**10 Hrs**
Module-4		
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. Case study: Soil Stabilization	**L1, L2,L3**	**10 Hrs**
Module-5		
Soil Reinforcement: Earth reinforcement – Principles and mechanism of reinforced earth-reinforced soil retaining structures, Synthetic and natural fibre based Geo textiles and their applications - Filtration, drainage, separation, and erosion control. Design Principles of steep reinforced soil slopes – pavements – Embankments on soft soils, introduction to soil nailing concepts, Case studies. **Miscellaneous Methods (Only Concepts & Uses):** Grouting: Introduction, Effect of grouting. Chemicals and materials used. Types of grouting, grouting procedure,	**L1, L2,L3**	**10 Hrs**

Applications of grouting. Thermal methods, Crib walls, Gabions and Mattresses, Anchors, Rock bolts, Stone Column, Micropiles, Case studies		

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: About the types of reinforcement and design principles, grouting techniques

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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*"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.
5. Relevant *IRC* and *MoRTH* Publications.

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URBAN TRANSPORT PLANNING

Course Code	MVJ19CTE14	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	50	**Total**	100
Credits	**04**	**Exam. Duration**	3 Hrs

Course Objectives

This course will enable students 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

Modules	RBT Level	Hrs.
Module-1		
Introduction: Introduction to transportation planning, scope and objective of UTP, various modes of transportation and comparisons, urban transportation system planning process, transportation demand and forecast.	**L1, L2,L3**	**10 Hrs**
Module-2		
Transportation Planning Process & Surveys: 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	**L1, L2,L3**	**11 Hrs**
Module-3		
Trip generation & Trip distribution: Trip generation: Trip purpose- Factors governing trip generation and attraction-Category analysis-Problems on above Trip distribution: Methods- Growth factors methods- Synthetic methods- Fratar and Furness method and problems on the above	**L1, L2,L3**	**11 Hrs**

Module-4		
Modal Split & Trip Assignment: Model Split: Factors affecting- characteristics of split- Model split in urban transport planning- problems on above Trip Assignment: Assignment techniques- problems on all techniques, minimum path tree problems.	**L1, L2,L3**	**10 Hrs**
Module-5		
Interdependency of Land Use & transport, characteristics of land use Models–Lowry Model- Hansen's Accessibility Model- Density- Saturation Gradient Model-Problems(Exception Lowry Model & DSGM)- Difficulties in planning small & medium cities- Recent case studies	**L1, L2,L3**	**08 Hrs**

Course outcomes

After the completion of the course students should be

CO1:. Know about methods of urban transportation planning in the India.

CO2: Able to apply knowledge of methods of designing apply travel demand modeling, Mode Choice Modeling and Traffic Assignment Modeling.

CO3: Able to gain knowledge of land use modeling.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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.

Web Link and Video Lectures:

1. http://nptel.ac.in

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INTELLECTUAL PROPERTY RIGHTS

Course Code	MVJ19IPR15	**CIE**	50
No. of Contact hours / Week	02	**SEE**	50
Total No. of Contact	25	**Total**	100
Credits	**02**	**Exam. Duration**	3 Hrs

Course Objectives

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

To discuss leading International Instruments concerning Intellectual Property Rights.

Modules	RBT Level	Hrs.
Module-1		
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, and Problems Encountered by Researchers in India.	**L1, L2,L3**	**10 Hrs**
Module-2		
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	**L1, L2,L3**	**11 Hrs**

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.		
Module-3		
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.	**L1, L2,L3**	**11 Hrs**
Module-4		
Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. **Interpretation and Report Writing:** Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout	**L1, L2,L3**	**10 Hrs**
Module-5		
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	**L1, L2,L3**	**08 Hrs**

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.		

Course outcomes

After the completion of the course students should be

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.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 16marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module. Students will have to answer 5 full questions, selecting one full question from each module.

Reference Books: Srinath.

1. L.S., *Advanced Mechanics of Solids*, Tata McGraw-Hill Publishing Delhi Co ltd., New

2. T.Y. Lin and Burn, "*Design of prestress concrete structures*", John Wiley, New York.

3. S. Ramamrutham, "*Prestressed concrete*", DhanpatRai& Sons, Delhi

4. IS: 1343: Indian Standard code of practice for Prestressed concrete, BIS, New Delhi.

6. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi.

Web Link and Video Lectures:

1. http://nptel.ac.in

I Semester, M.Tech, Transportation Engineering
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Highway Materials Testing Lab

Course Code	MVJ19CTEL16	**CIE**	50
No. of Contact hours / Week	03	**SEE**	50
Total No. of Contact	45	**Total**	100
Credits	**02**	**Exam. Duration**	3 Hrs

Course Objectives

This course will enable students 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

TESTS	RBT Level	Hrs.
TESTS ON AGGREGATES		
Basic tests such as crushing strength, abrasion value, impact value, combined index value, specific gravity and water absorption, shape tests, soundness test, stripping value of aggregates. Importance of all these tests in QA/QC.	**L1, L2,L3**	**15 Hrs**
TEST ON NEAT AND MODIFIED BITUMEN		
Basic tests on neat bitumen such as penetration, softening point, viscosity, ductility, flash and fire point and specific gravity. Basic tests on modified bitumen such as penetration, softening point, viscosity, elastic recovery, flash and fire point, specific gravity and loss on heating.	**L1, L2,L3**	**15 Hrs**
TEST ON BITUMINOUS MIXES		
Proportioning of materials by Rothfutch's method and Mix design by Marshall Method.	**L1, L2,L3**	**15 Hrs**

Course outcomes

After the completion of the course students should be

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

Web Link and Video Lectures:

1. http://nptel.ac.in

I Semester, M.Tech, Transportation Engineering
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Concrete and Geo-technical engineering Lab

Course Code	MVJ19CTEL17	**CIE**	50
No. of Contact hours / Week	03	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**02**	**Exam. Duration**	3 Hrs

Course Objectives

This course will enable students to:

- Explain CBR test to know the strength characteristics of soil
- Explain procedure for different tests on cement and mix design

TESTS	RBT Level	Hrs.
TEST ON SOILS		
CBR test, Compaction Tests, Unconfined Compression Test, Shear Tests	**L1, L2,L3**	**10 Hrs**
TEST ON CEMENT& CONCRETE		
Basic tests on cement concrete such as workability test, soundness test, compressive strength, split tensile strength and flexural strength. Concrete mix design by IS: 10262(2018). NDT Tests, Tests on Self Compacting Concrete	**L1, L2,L3**	**32 Hrs**

Course outcomes After the completion of the course students should be

CO1: Capable of analyzing the strength of soil by conducting CBR test

CO2: Able to analyze the properties of cement and do concrete 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

Web Link and Video Lectures:

1. http://nptel.ac.in

II Semester, M.Tech, Transportation Engineering
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PAVEMENT DESIGN AND ANALYSIS

Course Code	MVJ19CTE21	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	50	**Total**	100
Credits	**04**	**Exam. Duration**	3 Hrs

Course Objectives

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.

Modules	RBT Level	Hrs.
Module-1		
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	**L2,L3**	**10 Hrs**
Module-2		
Stresses And Deflections In Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister's two-layer theory, three layer and multi layer theories, Problems on above.	**L2,L3,L4**	**10 Hrs**
Module-3		
Flexible Pavement: Design Methods Principle, design steps, advantages and applications of different pavement design methods – Group Index, CBR, McLeod, Kansas Triaxial test, IRC, AASHTO and Asphalt Institute methods	**L2,L3,L4**	**10 Hrs**
Module-4		
Stresses In Rigid Pavements: Factors affecting design and performance of pavements. Types of stresses and causes,	**L2,L3,L4**	**10 Hrs**

factors influencing the stresses, general considerations in rigid pavement analysis, EWL, wheel load stresses, warping stresses, frictional stresses, combined stresses. Problems on above.		
Module-5		
Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacing, design of CC pavement for roads and runways, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements. Problems on above	**L2,L3,L4**	**10 Hrs**

Course outcomes:

After completion of the course the student will be able to

CO1: List and explain the various factors affecting design and performance of pavements.

CO2: Calculate the stresses and deflection in flexible and rigid pavements.

CO3: Design flexible and rigid pavements.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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 Book Co.
3. Khanna and Justo, 'Test Book of Highway Engineering 'Nemchand brothers, Roorke-2004.
4. Huang, 'Pavement Analysis', Elsevier Publications
5. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers.
6. Pavement and Surfacing for Highway & Airports, Micheal Sargious, Applied SciencePublishers Limited.
7. Haas and Hudson `Pavement Management System', McGraw Hill Book Co., New York.
8. HRB/TRB/IRC/International Conference on Structural Design of Asphalt Pavements.
9. Relevant IRC Publications
10. CMA Hand Book

Web Link and Video Lectures:

1. http://nptel.ac.in

II Semester, M.Tech, Transportation Engineering
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TRANSPORTATION ECONOMICS AND EVALUATION

Course Code	MVJ19CTE22	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	50	**Total**	100
Credits	**04**	**Exam. Duration**	3 Hrs

Course Objectives

- 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

Modules	RBT Level	Hrs.
Module-1		
Principles of Economics: Supply and demand models, Consumer's surplus and social surplus criteria, and framework for social accounting: accounting rate of interest, social opportunity cost, rate of interest, social time preference rate of interest, accounting prices of goods and services, measuring input costs, applications on social accounting.	**L2,L3**	**10 Hrs**
Module-2		
Transport Costs and Benefits: Fixed and variable cost, cost of improvement, maintenance cost, cost estimating methods, accounting for inflation, external costs, Direct benefits: reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost.	**L3, L4**	**10 Hrs**
Module-3		
Project Evaluation : Framework of evaluation, transport planning evaluation at urban and regional levels, other	**L2,L3**	**11 Hrs**

evaluation procedures, environmental evaluation, safety evaluation, project financing.		
Module-4		
Economic Analysis: Generation and screening of project alternatives, different methods of economic analysis: annual cost and benefit ratio methods, discounted cash flow methods, shadow pricing techniques, determination of IRR and NPV, examples of economic analysis, application economic theory in traffic assignment problem.	**L2,L3**	**10 Hrs**
Module-5		
Environmental impact assessment : Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety and Capacity Impacts – Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical case studies	**L2,L6**	**08 Hrs**

Course outcomes

After the completion of the course students should be

CO1: Able to understand terminology of economics and its application in transportation

CO2: Able to understand components involved in economic evaluation, and methods.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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.

Web Link and Video Lectures:

1. http://nptel.ac.in

II Semester, M.Tech, Transportation Engineering
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RAILWAYS AND AIRWAYS

Course Code	MVJ19CTE23	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	50	**Total**	100
Credits	**04**	**Exam. Duration**	3 Hrs

Course Objectives

- 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

Modules	RBT Level	Hrs.
Module-1		
Permanent way and its requirements, Gauges and types, Typical cross sections, Coning of wheels and Tilting of rails, Components- Types, sections length- Defects- wear- creep- welding- joints. Track fitting and fastener, Calculation of quantity of materials, Tractive resistances and hauling capacity- **Numerical examples**	**L2,L3,L4**	**10 Hrs**
Module-2		
Geometric Design: Necessity, Safe speed on curves. Cant, cant deficiency, negative cant, safe speed, Transition curve, gradient, grade compensation Points and Crossings: Components of a turnout, design of turnouts, types of switches, crossings, track junctions. Stations and yards. Signaling: Objects and types of signals. Fouling mark, buffer stop, level crossing, track defects- Numerical examples	**L2,L3,L4**	**10 Hrs**
Module-3		
Railway sections and yards - Purpose, site selection, facilities, requirements, classification, platforms, building areas, types of yards, foot over bridges, subways, cranes,	**L2,L3**	**10 Hrs**

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		
Module-4		
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.	**L2,L3,L4**	**10 Hrs**
Module-5		
Taxiway: Factors affecting the layout - geometrics of taxiway-Design of exit taxiway - Numerical examples. Visual aids- Airport marking – lighting-Instrumental Landing System. Heliports and their Design: Introduction, Helicopter characteristics, planning of heliports, Visual aids of heliports	**L2,L3,L4**	**10 Hrs**

Course outcomes

After the completion of the course students should be

CO1: Describe about railways and its design.

CO2: Analyze the points and crossings.

CO3: Describe about airports design and runways.

CO4: Analyze the design of heliports

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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
4. R Srinivasan, “Docks and Tunnel Engineering”, Charotar Publishing House
5. H P Oza and G H Oza, “Docks and Harbour Engineering”, Charotar Publishing House
6. B C Punmia, “Surveying”, Laxmi Publications.
7. Mundrey, “Railway Engineering”, McGraw Hill Publications

Web Link and Video Lectures:

1. http://nptel.ac.in

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THEORIES OF TRAFFIC FLOW

Course Code	MVJ19CTE241	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**03**	**Exam. Duration**	3 Hrs

Course Objectives

- 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.

Modules	RBT Level	Hrs.
Module-1		
Traffic Stream Parameters - Fundamental diagram of volume-speed-density surface. Discreteand continuous probability distributions. Merging manoeuvres - critical gaps and their distribution.	**L2,L3,L5**	**10 Hrs**
Module-2		
Macroscopic Models - Heat flow and fluid flow analogies - Shock waves and bottleneck control approach.	**L2,L3,L4**	**08 Hrs**
Module-3		
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..	**L2,L3,L4**	**08 Hrs**
Module-4		
Linear And Non-Linear Car Following Models - Determination of car following variables -Acceleration noise.	**L2,L3,L4**	**08 Hrs**
Module-5		
Geographical Information System – Global Positioning System – Intelligent Transportation Systems - Area Traffic Control – Automatic Toll Col lection – Smart Cards –	**L2,L3,L4**	**08 Hrs**

Collision Detection System.		

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

CO1: Able to apply the flow theories to field situations such as toll booths, diversion measures etc.

CO2: Able to understand various car following theories

CO3: Able to apply the concepts of vehicle arrivals to field situations such as exit ramps, entry ramps etc by queuing theory

CO4: Able to appreciate the application of GIS techniques in traffic engineering.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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

Web Link and Video Lectures:

1. http://nptel.ac.in

II Semester, M.Tech, Transportation Engineering
[As Per Choice Based Credit System (CBCS)]
Effective from the Academic Year 2019 -2020

GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES

Course Code	MVJ19CTE242	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**03**	**Exam. Duration**	3 Hrs

Course Objectives

- 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.

Modules	RBT Level	Hrs.
Module-1		
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.	**L2,L3**	**10 Hrs**
Module-2		
Transportation Planning Process & Surveys: 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 **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	**L2,L3,L4**	**08 Hrs**

intersections		
Module-3		
Vertical alignment: Classification of grades, change of gradients, 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.	**L2,L3,L4**	**08 Hrs**
Module-4		
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.	**L2,L3,L4**	**08 Hrs**
Module-5		
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.	**L2,L3**	**08 Hrs**

Course outcomes

After the completion of the course, students should be

CO1: Able to understand importance and design geometric elements.

CO2: Able to understand sight distances and the components of horizontal and vertical alignment.

Question paper pattern:

The question paper will have ten questions.

- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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

Web Link and Video Lectures:

1. http://nptel.ac.in

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PAVEMENT MANAGEMENT SYSTEM

Course Code	MVJ19CTE251	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**03**	**Exam. Duration**	3 Hrs

Course Objectives

This course will enable students 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

Modules	RBT Level	Hrs.
Module-1		
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.	**L2,L3**	**08 Hrs**
Module-2		
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.	**L2,L3,L4**	**10 Hrs**
Module-3		

Evaluation of Pavement Distress and Functional Aspects – Principles- Condition survey- Survey Methodology-Types of Distress-Examples-Equipment-Indexes-Applications of Distressdata- 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.	**L2,L3,L4**	**08 Hrs**
Module-4		
Expert Systems and Pavement Management - Implementation of Pavement Management Systems.	**L2,L3,L4**	**08 Hrs**
Module-5		
Road Asset Management: Management, Data and Modeling, Planning Application	**L2,L3,L4**	**08 Hrs**

Course outcomes After the completion of the course students should be

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

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

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.

Web Link and Video Lectures:

1. http://nptel.ac.in

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APPLIED STATISTICS

Course Code	MVJ19CTE253	**CIE**	50
No. of Contact hours / Week	04	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**03**	**Exam. Duration**	3 Hrs

Course Objectives

Course Objectives: This course will enable students 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.

Modules	RBT Level	Hrs.
Module-1		
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.	**L1, L2,L3**	**10 Hrs**
Module-2		
Probability: Review, Addition & Multiplication Rules, random Variables, Discrete distributions– Binomial & Poisson Distributions, Continuous Distribution – Uniform, Exponential, Gamma& normal Distributions, applications in Highway engineering problems.	**L1, L2,L3**	**08 Hrs**
Module-3		
Statistical decisions: hypothesis testing, significance levels	**L1, L2,L3**	**08 Hrs**

– Tests concerning Mean, testing the equality of means of two populations, tests concerning the variance. Chi–square Test for goodness of fit. Confidence Interval.		
Module-4		
Time series analysis- introduction –moving average- Problems	**L1, L2,L3**	**08 Hrs**
Module-5		
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.	**L1, L2,L3**	**08 Hrs**

Course outcomes

After the completion of the course students should be

- Able to use appropriate statistical method in transportation engineering problems.
- Capable of applying the rule of probability and discrete distributions in solving problems.
- Capable of testing the goodness of fit by using statistical decision.
- Able to apply the knowledge of optimization technique and use statistical software in analysis of transportation engineering problems.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. **Gupta,S.C.andKapoorV.K.** Fundamentals of Mathematical statistics,
2. Sultan Chand andSons,1978. **MedhiJ**(1982) Introduction to statistics. New age publications, New Delhi.
3. **WalpoleR.E.andR.H.Mayers(1982)** Probability and statistics for Engineers and Scientists .WileyIntl.2 002.
4. **Johnson Rand G.Bhattacharya (1985):** Statistics– principles and methods. John Wiley,NY.
5. **Ross S. M.**Probability and statistics for Engineers.Wiley Int.Edition.
6. **KadiyaliL.R.**Traffic Engineering and Transport Planning, Khanna Publishers,2004

Web Link and Video Lectures:

1. http://nptel.ac.in

II Semester, M.Tech, Structural Engineering
[As Per Choice Based Credit System (CBCS)]
Effective from the Academic Year 2019 -2020

Sustainability Concepts in Engineering

Course Code	MVJ19CXX261	**CIE**	50
No. of Contact hours / Week	03	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**03**	**Exam. Duration**	3 Hrs

Course Objectives

- Learn about the principles, indicators and general concept of sustainability.
- Apprehend the local, regional and global impacts of unsustainable designs, products and processes.
- Student shall be able to 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.

Modules	RBT Level	Hrs
Module-1		
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	**L1,L2,L3**	**8 Hrs**
Module-2		
Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration –Carbon capture and sto rage (CCS). Environmental management standards, ISO 14000 series, Life	**L1,L2,L3**	**8 Hrs**

Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking		
Module-3		
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.	**L1,L2,L3,L4**	**10 Hrs**
Module-4		
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	**L1,L2,L3**	**8 Hrs**
Module-5		
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.	**L1,L2,L3**	**8 Hrs**

Course outcomes:

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: Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Malcolm Dowden, Climate Change and Sustainable Development: Law, Policy and Practice
6. Daniel A. Vallero and Chris Brasier, " Sustainable Design: The Science of Sustainability and Green Engineering", Wiley-Blackwell
7. Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers

Web Link and Video Lectures:

1) http://qcin.org/CAS/RMCPC/

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[As Per Choice Based Credit System (CBCS)]

Effective from the Academic Year 2019 -2020

Remote Sensing and GIS

Course Code	MVJ19XXX262	**CIE**	50
No. of Contact hours / Week	03	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**03**	**Exam. Duration**	3 Hrs

Course Objectives

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

Modules	RBT Level	Hrs
Module-1		
Remote Sensing: Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation),Resolution, image registration and Image and False color composite, elements of visual interpretation techniques.	**L1,L2,L3**	**8 Hrs**
Module-2		
Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms-IRS, Landsat, SPOT, Cartosat, HoursIkonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal). Basics of digital image processing- introduction to digital data, systematic errors(Scan Skew, Mirror-Scan Velocity,	**L2,L3,L4**	**10 Hrs**

Panoramic Distortion, Platform Velocity , Earth Rotation) and non-systematic [random] errors(Altitude, Attitude), Image enhancements(Gray Level Thresholding, level slicing, contrast stretching),image filtering		
Module-3		
Geographic Information System: Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute data-Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones	**L2,L3,L4**	**8 Hrs**
Module-4		
Data Models: Vector data model: Representation of simple features –Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion.	**L3,L4,L5**	**8 Hrs**
Module-5		
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.	**L3,L4,L5,L6**	**8 Hrs**

Course outcomes:

CO1: Collect data and delineate various elements from the satellite imagery using their spectral signature.

CO2: Analyze 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.

CO3: Perform digital classification and create different thematic maps for solving specific problems

CO4: Make decision based on the GIS analysis on thematic maps.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. Chor Pang Lo and Albert K.W Yeung, "Concepts & Tech niques of GIS", PHI, 2006 2.
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 Geograperhical i nformation system", B.S. Publications 2008.
4. Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Informa tion system", Oxford Publications 2004.
5. S Kumar, "Basics of remote sensing & GIS", Laxmi pu blications 2005.

Web Link and Video Lectures:

2) http://qcin.org/CAS/RMCPC/

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Effective from the Academic Year 2019 -2020

Occupational Health and Safety

Course Code	MVJ19XXX263	**CIE**	50
No. of Contact hours / Week	03	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**03**	**Exam. Duration**	3 Hrs

Course Objectives

- Gain an historical, economic, and organizational perspective of occupational safety and health.
- Investigate current occupational safety and health problems and solutions. Extract the GIS data and prepare the thematic maps
- Identify the forces that influence occupational safety and health.
- Demonstrate the knowledge and skills needed to identify workplace problems and safe work practice

Modules	RBT Level	Hrs
Module-1		
Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act(OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation	**L1,L2,L3**	**8 Hrs**
Module-2		
Ergonomics at Work Place: Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis –Fault Tree Analysis – Emergency Response - Decision for action – purpose and	**L2,L3,L4,L5**	**8 Hrs**

Considerations.		
Module-3		
Fire Prevention and Protection: Fire Triangle, Fire Development and itsseverity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. Electrical Safety, Product Safety: Technical Requirements of Product safety	**L2,L3,L4,L5**	**8 Hrs**
Module-4		
Health Considerations at Work Place: types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability	**L2,L3,L4,L5**	**8 Hrs**
Module-5		
Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors	**L3,L4,L5.L6**	**10 Hrs**

Course outcomes:

CO1: Identify hazards in the workplace that pose a danger or threat to their safety or health, or that of others.

CO2: Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.

CO3: Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation.

CO4: Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.

CO5: Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks

- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. Colling D.A., (1990), "Industrial Safety Management and Technology", Prentice Hall, New Delhi.
2. Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc.
3. Goetsch D.L., (1999), "Occupational Safety and Heal th for Technologists, Engineers and Managers", Prentice Hall
4. Heinrich H.W., (2007), "Industrial Accident Prevention - A Scientific Approach", McGraw-Hill Book Company
5. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "Industrial Safety and Pollution Control Handbook.

Web Link and Video Lectures:

3) http://qcin.org/CAS/RMCPC/

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Effective from the Academic Year 2019 -2020

TRANSPORTATION ENGINEERING LAB

Course Code	MVJ19CTEL27	**CIE**	50
No. of Contact hours / Week	03	**SEE**	50
Total No. of Contact	42	**Total**	100
Credits	**02**	**Exam. Duration**	3 Hrs

Course Objectives

Illustrate application of soft computing techniques for solving transportation problems

• Illustrate the application of software for analyzing traffic survey data

• 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

Modules	RBT Level	Hrs
Module-1		
ANALYSIS OF TRAFFIC SURVEYS: Classified volume count survey • Highway capacity Estimation. • Moving car method • LoS study • Origin and destination studies • Delay studies.• Pedestrian Survey. • Parking studies.	**L1,L2,L3**	**12 Hrs**
Module-2		
PAVMENT EVALUATION LAB Road inventory • Pavement Condition Studies	**L2,L3,L4,L5**	**09 Hrs**
Module-3		
HIGHWAY GEOMETRY: Design of horizontal alignment, vertical alignment, generating cross section and design of intersections.	**L2,L3,L4,L5**	**09 Hrs**
Module-4		
PAVEMENT DESIGN: Design of flexible pavement using IRC-37:2012	**L2,L3,L4,L5**	**12 Hrs**

Kenpave analysis		

Course outcomes:

The student should be able to

• Examine and arrive at required output from traffic surveys

• Identify the adequacy of the pavement performance- functional and structural.

• Analyse and generate models for transportation planning.

• 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.