

12-08-2024/25

**204M.Tech., Highway Technology (MCHT)  
(Effective from the Academic year 2024-25)**

**Program Outcome of this course:** After successful completion of the program, the postgraduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

## Semester- 2

PAVEMENT ANALYSIS AND DESIGN (IPCC)			
Course Code	MCHT201	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:2:0	SEE Marks	50
Total Hours of Pedagogy	39 Hr Theory + 26 Hr. Practice	Total Marks	100
Credits	04	Exam Hours	03
<b>Course objectives:</b>			
This course will enable students to			
Understand the factors affecting pavement design and performance			
Evaluate the strength of soil subgrade and factors that affect the behavior of soil.			
Compute the stresses and deflections in flexible and rigid pavement layers under the action of wheel loads.			
Design the thickness of flexible pavements by different methods under different exposure conditions and materials.			
Design the thickness of concrete pavements and joints associated with CC pavements in addition to the computation of stresses in CC pavements.			
<b>MODULE-1</b>			
<b>Pavements and pavement layers</b> - types, functions, Highway and Airfield pavements, axle load distribution, ESWL, EWL, VDF due to varying loads and CSA. Flexible pavement design factors			
<b>Teaching-Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, Field studies		
<b>MODULE-2</b>			
Subgrade support - CBR and plate bearing tests, Resilient Modulus, fatigue tests, permanent deformation Pavement Material Characterization, climatic, drainage and environmental factors, their effects and evaluation. Factors affecting design and performance of airport pavements.			
<b>Teaching-Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, Lab tests and Field studies		
<b>MODULE-3</b>			
<b>Stresses in Flexible pavements:</b> Layered System concepts, Stress solution for one, two- and three-layered systems. Applications in pavement design. Problems			
<b>Stresses in Rigid Pavements:</b> Westergaard's theory and assumptions, Stresses due to Curling, stresses and deflection due to loading, frictional stresses. Stresses in dowel bars and tie bars.			
<b>Teaching-Learning Process</b>	Black board, LCD, Skill enhancement through problem solving		
<b>MODULE-4</b>			
<b>Flexible pavement design:</b> Empirical, semi-empirical and theoretical design approaches, principle, advantages and application. Design steps by CBR method as per IRC, outline of other common design methods such as AASHTO and Asphalt Institute methods, Problems.			
<b>Application of IIT PAVE software, ANSYS, KENPAVE, KENLAYER, AASHTOWARE</b>			
<b>Teaching-Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, Demo and learning of design software		
<b>MODULE 5</b>			
<b>Rigid pavement design:</b> Rigid pavement design factors, Determination of ESWL, EWL for dual and dual tandem wheel loads in Rigid pavements, General design principle, design of cement concrete pavements (joints and slab thickness) as per IRC/PCA guidelines. Design features of CRCP, SFRC and ICBP, Problems. Application of Design Software			
<b>Teaching-Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, Demo and learning of design software.		

**PRACTICAL COMPONENT OF IPCC** (May cover all / major modules)

Sl.NO	Experiments
1	Classified traffic volume studies, Axle load survey
2	Subgrade strength evaluation tests such as California Bearing Ratio (CBR), Triaxial compression, direct shear test
3	Determination of field density of pavement layers by sand replacement method, core cutter method
4	The field CBR test or in –situ CBR value by Dynamic Cone Penetration Test
5	Tests on Bituminous Pavement Layers: <ol style="list-style-type: none"> <li>1. Destructive test:               <ol style="list-style-type: none"> <li>a. To determine density, void analysis, bitumen content and aggregate gradation after bitumen extraction by Core drilling</li> <li>b. Test Pit investigations</li> </ol> </li> </ol>
6	Design of Flexible pavements using IIT-PAVE software for flexible pavement Design as per IRC 37 2018
7	Design of Rigid Pavements as per IRC:58-2015(MS-Excel)
<p><b>Assessment Details (both CIE and SEE)</b>            The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>CIE for the theory component of IPCC</b></p> <ol style="list-style-type: none"> <li>1. Two Tests each of <b>20 Marks</b></li> <li>2. Two assignments each of <b>10 Marks/One Skill Development Activity of 20 marks</b></li> <li>3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to <b>30 marks</b>.</li> </ol> <p><b>CIE for the practical component of IPCC</b></p> <ul style="list-style-type: none"> <li>• On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The <b>15 marks</b> are for conducting the experiment and preparation of the laboratory record, the other <b>05 marks shall be for the test</b> conducted at the end of the semester.</li> <li>• The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.</li> <li>• The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks.</li> </ul> <p>Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for <b>20 marks</b>.</p> <p><b>SEE for IPCC</b>            Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)</p> <ol style="list-style-type: none"> <li>1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.</li> <li>2. The question paper will have ten questions. Each question is set for 20 marks.</li> <li>3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), <b>should have a mix of topics</b> under that module.</li> </ol>	

<p>4. The students have to answer 5 full questions, selecting one full question from each module.  <b>The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.</b>  <b>Questions mentioned in the SEE paper shall include questions from the practical component).</b></p> <ul style="list-style-type: none"> <li>The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.</li> <li>SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course (CIE+SEE))</li> </ul>
<p><b>Suggested Learning Resources:</b>  <b>Books</b>  <b>Text Books:</b>  1. Yang H. Huang, "Pavement Analysis and Design", Second Edition, Pearson Education, 2008.  2. Rajib B. Mallick and Tahar EL-Korchi, "Pavement Engineering Principles and Practice", Third Edition, CRC Press Taylor and Francis Group.  3. Yoder, E. J. and Witzczak, M. W., "Principles of Pavement Design", Second Edition, John Wiley and sons  <b>Reference Books:</b>  1. Huang, "Pavement Analysis"- Elsevier Publications  2. David Croney, Paul Croney, "Design &amp; Performance of Road Pavements"- Mc Graw hillBook Co. 3. W.Ronald Hudson, Ralph Haas and Zeniswki  3. "Modern Pavement Management"- McGraw Hill and Co.  4. S.K. Khanna, C.E.G Justo and A. Veeraragavan "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10th Edition.  5. Relevant IRC Code</p>
<p><b>Web links and Video Lectures (e-Resources):</b>  1) <a href="https://www.youtube.com/watch?v=uJntL0gEHD4">https://www.youtube.com/watch?v=uJntL0gEHD4</a>  2) <a href="https://youtu.be/HLVihGDdsSM">https://youtu.be/HLVihGDdsSM</a>  3) <a href="https://youtu.be/GxXONAINMBE">https://youtu.be/GxXONAINMBE</a></p>
<p><b>Activity Based Learning (Suggested Activities in Class)/ Practical Based learning</b></p> <ul style="list-style-type: none"> <li>Determining various design factors such as VDF, ESWL, CSA through Problem solving</li> <li>Lab Testing of subgrade soil to determine its basic properties such as Grain size analysis, Atterberg limits, MDD and OMC, CBR etc.</li> <li>Lab testing of other pavement materials such as aggregates, Bitumen, cement, Bituminous mixes and concrete  Learning Design Software for flexible and Rigid pavement design</li> </ul>

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No	Description	Blooms Level
CO1	Understand the factors affecting pavement design and performance.	L1, L2, L3, L4
CO2	Evaluate the strength of soil subgrade and other factors that influence pavement design.	L2, L5
CO3	Compute the stresses and deflections in flexible and rigid pavement layers	L1, L2, L3, L4, L5
CO4	Design the flexible pavements by IRC methods and also know the outline of other design methods.	L1, L2, L3, L4, L5, L6
CO5	Design the thickness of concrete pavements and joints associated with CC pavements and design outline of special concrete pavements.	L1, L2, L3, L4, L5, L6

**Program Outcome of this course**

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	Possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x	x			x	x			x
CO2	x			x	x		x		
CO3	x			x	x		x		
CO4	x	x		x	x	x			
CO5	x	x		x	x	x			

## Semester- 2

HIGHWAY CONSTRUCTION TECHNOLOGY (PCC)			
Course Code	MCHT202/MCEM202	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>Understand the various equipment used for road construction and difficulties associated with highway drainage.</li> <li>Select suitable equipment for preparation of subgrade in cutting or filling and also the preparation steps for base and sub base layers.</li> <li>Characteristics of different types of bituminous layers and design of bituminous surfacing along with safety aspects needed for roads.</li> <li>Design the base course thickness and selection of materials as base layer for CC pavements.</li> <li>Analyse the defects in road construction and general pavement failures with remedies.</li> </ul>			
<b>Module-1</b>			
<p><b>Plants and Equipment:</b> Components of pavement structure, functions and requirements, Plants and equipment: Excavators, graders, compactors, crushers, bituminous hot mix plants, cement concrete mixers, pavers - uses in road construction.</p>			
<b>Teaching- Learning Process</b>	Students can be taken to the construction site. Assignments can be given to evaluate the details of different types of equipment used in road construction		
<b>Module-2</b>			
<p><b>Construction of Subgrade and Sub base:</b> Specifications and steps for construction of subgrade, sub base, quality control tests  <b>Construction of granular layers:</b> Specifications and steps of construction, WBM, WMM, CRM, quality control tests  <b>Construction of Bituminous Layers:</b> Different types of bituminous layers, specifications and construction of bituminous layers, quality control tests</p>			
<b>Teaching- Learning Process</b>	Students can be given the field assignment to evaluate the degree of compaction of different pavement layers. Practically involving them to observe the methodology of construction.		
<b>Module-3</b>			
<p><b>Construction of Cement Concrete Pavements:</b> Specifications and steps for construction of DLC, Paving Quality Concrete pavements, quality control tests Specifications and steps for construction of White topping, Interlocking concrete block pavements, quality control tests.  <b>Safety during Construction:</b> Safety aspects during construction and maintenance works, road safety furniture.</p>			
<b>Teaching- Learning Process</b>	Students can be given the field assignments to make details note of How rigid pavements are constructed at the site. To make them understand the difference between DLC. PQC, Quality control checks, joints etc.		
<b>Module-4</b>			
<p><b>Drainage:</b> Assessment of drainage requirements for the road, design of various drainage components, drainage materials, surface and sub-surface drainage system for roads, drainage of urban roads.</p>			
<b>Teaching- Learning Process</b>	Ongoing projects field data can be given to evaluate the validity of the given type of drainage, its design or can be given assignment to redesign the drainage.		
<b>Module-5</b>			
<p><b>Maintenance and Rehabilitation of bituminous and concrete pavements:</b> Routine and periodic maintenance, preventive and reactive maintenance for drainage and pavements, Preparation of existing pavement for patching, profile correction, special measures to deal with reflection cracks in pavement overlays, requirements for rehabilitation, recycling.  Recycling of pavements- cold recycling, hot recycling, Full Depth Reclamation, road construction in water logged areas, design and construction of RE walls to be added.</p>			
<b>Teaching- Learning Process</b>	Field studies can be offered to the students to evaluate the pavement condition with respect to the distress, and to suggest suitable maintenance program.		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. "Highway Engineering", Khanna and CEG Justo, A. Veeraragavan, revised 10<sup>th</sup> edition, published by Nem Chand & Bros, Roorkee, ISBN:978-81-85240-80-0
2. Prithvi Singh Kandhal, "Bituminous Road Construction in India", ISBN: 978- 8120352582
3. Delatte N. J., Concrete Pavement Design, Construction, and Performance, CRC Press, Taylor & Francis Group, 2014

**Reference Books:**

1. MoRTH "Specifications for Roads and Bridge Works" - 2013 Fifth revision, Indian Roads Congress
2. MoRTH "Manual for Construction and Supervision of Bituminous Works"- 2001, Indian Roads Congress
3. MoRTH "Manual for Maintenance of Roads"- 1989, Indian Roads Congress
4. "Pavement Drainage- Theory and Practice", G.L. Shivakumar Babu, Prithvi S Kandhal, Nivedya Mandankara Kottayi, Rajib Mallick, A. Veeraragavan
5. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2nd Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA
6. National Asphalt Pavement Association "Hot Mix Asphalt Paving Handbook"- 5100 Forbes Boulevard, Lanham, Mary Land, USA
7. "Handbook on Cement Concrete Roads"- Cement Manufacturers Association, New Delhi  
Relevant IRC Codes

**Web links and Video Lectures (e-Resources):**

<https://nptel.ac.in/courses/105101087>

**Skill Development Activities Suggested**

- Site visits when construction is ongoing
- Working on case studies

**Course outcome (Course Skill Set) S**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand the different types of equipment used in road construction and their importance at different stages of construction	L2
CO2	Understand the construction procedures of sub grade, sub base and base course and bituminous layers in flexible pavement. Acquire the knowledge of quality control checks on the materials before, during construction and after construction	L2

12-08-2024/25

CO3	Understand the construction of CC pavements, quality control checks, concepts of white topping on distressed bituminous layers. Also introduced to the alternate materials being in used instead of conventional ones.	L2
CO4	Understand the importance of drainage in highway construction, design of drainages under different pavement conditions and rain fall data	L2, L3
CO5	Understand the causes for pavement distress of both flexible and rigid pavements, implementing suitable remedial measures at the site.	L3, L4



**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x		x	x					
CO2			x		x				
CO3			x						
CO4			x		x				
CO5						X			

## Semester- 2

ROAD GEOMETRIC DESIGN (PCC)			
Course Code	<b>MCHT203</b>	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>• Understand the Geometrical design elements.</li> <li>• Plan the geometric elements for varying conditions of roads.</li> <li>• Examine the geometric elements for highway geometric design.</li> <li>• Judge and propose the geometric element facilities for varying highway conditions</li> </ul>			
<b>Module-1</b>			
<p><b>Introduction:</b> Importance, Factors governing geometric design, route selection, geometric design consistency, capacity of rural and urban roads.</p> <p><b>Cross Section Elements:</b> Right of way and width consideration, roadway, shoulders, Kerbs, traffic barriers, medians, service roads, pavement surface characteristics, cross slope, skid resistance, unevenness.</p>			
<b>Teaching-Learning Process</b>	Students can be exposed to practical assignments by collecting the details of road way elements, to evaluate the vehicular characters and its application in highway geometry		
<b>Module-2</b>			
<p><b>Geometric Design Elements</b> for inter-city highways and expressways: Sight Distances-SSD, ISD, OSD, factors governing sight distances, Design of horizontal alignment-overtaking and skidding, super elevation, extra widening, transition curves, Design of vertical alignment, - gradient, vertical curves.</p>			
<b>Teaching-Learning Process</b>	Live data of the road way geometry can be an assignment and its proof checking will make the student to understand the deficiency. Student can able design SSD, OSD and super elevation.		
<b>Module-3</b>			
<p><b>Intersection Design:</b> At grade intersections- sight distance consideration and principles of design, Channelization, mini roundabout, roundabout, Inter-changes- major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes.</p>			
<b>Teaching-Learning Process</b>	Can understand the importance of controlled intersections, different types of roundabout, channelization of roads		
<b>Module-4</b>			
<p><b>Roadway facilities:</b> Pedestrian facilities, bus bay, truck lay bays, frontage roads, parking areas, cattle crossings, lighting, toll plazas, and maintenance center, landscaping and tree plantation.</p>			
<b>Teaching-Learning Process</b>	Can understand the necessity of pedestrian facility, parking areas, bus bays street lighting. Field assignments can be offered to investigate provision of such facility.		
<b>Module-5</b>			
<p><b>Geometric Design of Hill Roads:</b> Classification, width of road land, roadway, carriageway, design speed, sight distances, horizontal alignment, vertical alignment, hairpin bends, passing places, lateral and vertical clearances.</p> <p><b>Use of software: Mx Roads/ Open roads, / Civil 3D</b></p>			
<b>Teaching- Learning Process</b>	Can understand the geometry of the hill roads, construction methods in hilly area, providing the passing sight distances, designing of curves, drainage		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

1.

**Suggested Learning Resources:****Books**

- 1) Highway Engineering, S.K. Khanna, C.E.G Justo and A. Veeraragavan, Nem Chand and Bros., Roorkee. Revised 10<sup>th</sup> Edition, ISBN: 978-8185240930
- 2) A Policy on Geometric Design of Highways and Streets, (The Green Book) 7<sup>th</sup> Edition, American Association of State Highway and Transportation Officials (AASHTO) Publishers, 2018, ISBN Number: 978-1-56051-676-7
- 3) Geometric Design Projects for Highways: An Introduction, John G Schoon, 2<sup>nd</sup> Edition, American Society of Civil Engineers Press, ISBN:978-0-7844-7042-8, 2000
- 4) Relevant Indian Road Congress Code Books (IRC)

**Web links and Video Lectures (e-Resources):**

<https://archive.nptel.ac.in/courses/105/107/105107220/>

**Skill Development Activities Suggested**

- Design the geometrics with the data collected by surveying for a road project by mathematical means
- Design the geometrics with the data collected by surveying for a road project by using Civil 3D or other design softwares.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Cross sectional details of the road, road way geometry, concept of arriving at the width of the single lane and multi lanes	L2
CO2	Calculate the stopping sight distance, overtaking sight distance, designing of the super elevation, designing of vertical alignments	L4
CO3	Design the intersections, calculating the sight distance	L4, L3
CO4	Understand the importance of road way facility- frontage, parking areas, pedestrian facility	L2

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x	x							
CO2	x		x		x	x			
CO3			x	x	x	x			
CO4		x			x				

<b>COURSE TITLE: CONSTRUCTION PLANNING AND ECONOMICS</b> [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Subject Code	MCHT204	CIE Marks	50
Number of Lecture Hours/Week	04	SEE Marks	50
Total Number of Lecture Hours	50	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course Learning objectives: This course will enable students to</b>			
<ul style="list-style-type: none"> <li>Analyze construction methods and strategies for highway projects.</li> <li>Apply project management tools for construction monitoring and control.</li> <li>Understand highway economics principles and concepts.</li> <li>Analyze costs and benefits of highway projects.</li> <li>Evaluate economic viability of highway projects.</li> </ul>			
<b>Modules</b>			<b>Teaching Hours</b>
<b>Module -1</b>			
Various types of highway development projects in progress in India and their scope. Factors to be considered in planning of new highway /expressway / bypass and up-gradation of existing roads. <b>Planning of Road Projects</b> –project management framework, scope, project objectives, project environment, causes of project failure, project development process <b>Resource planning</b> – human resources, project man power grouping, structuring site organization, construction materials- classification of construction materials, materials usage, materials inventory, cost and budget			<b>10 Hours</b>
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Blackboard teaching/PowerPoint presentations (if needed)</li> <li>Regular review of students by asking questions based on topics covered in the class.</li> <li>Compliment the understanding of case studies.</li> </ol>		
<b>Module -2</b>			
<b>Time planning</b> – project work breakdown, determining activities involved, assessment of duration, CPM / PERT network analysis, work scheduling, methods of work scheduling, factors affecting work scheduling, Problems. <b>Planning Control System</b> – resource production, project cost, project time, codification and project management, information system, use of software <b>Use of softwares: Primavera V8i, MSP (Microsoft project), PPM (Project Portfolio Management)</b>			<b>10 Hours</b>
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Blackboard teaching/PowerPoint presentations (if needed)</li> <li>Regular review of students by asking questions based on topics covered in the class.</li> <li>Compliment the understanding by discussing case studies</li> </ol>		
<b>Module -3</b>			
<b>Highway Engineering Economics, principle, supply and demand models, equilibrium, sensitivity of travel demand, Elasticities</b> – types, models (Kraft demand model) consumer surplus cost – cost elasticity pricing and subsidy policies, rates of interest, Vehicle operation cost, direct and indirect benefits due to road improvement, Total transportation cost, fixed and variable costs. Road user cost studies in India.			<b>10 Hours</b>
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Blackboard teaching/PowerPoint presentations (if needed)</li> <li>Regular review of students by asking questions based on topics covered in the class.</li> </ol>		
<b>Module -4</b>			
<b>Economic analysis</b> , different methods, determination of annual cost, benefit cost ratio, IRR, FIRR, NPV. Sensitivity of economic analysis, Examples of economic analysis for different types of road improvement measures, pavement options, construction of bypasses and upgrading of intersections. Project priorities, methods of dealing with uncertainties.			<b>10 Hours</b>

**Kommentiert [1]:** Refer Winfrey and also <https://www.sapnaonline.com/books/theory-applications-economics-highway-transport-vinay-maitri-8180141438-9788180141430>

<b>Module -5</b>	
<b>Highway financing</b> , various options for road and bridge projects, special cess, tolling, BOT, BOOT and other options. Economic and financial analysis of highway projects and use of computer software packages. Road investment decision packages. <b>Use of software: HDM-4 software, Primavera V8i, MSP (Microsoft project), PPM (Project Portfolio Management)</b>	<b>10 Hours</b>
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Blackboard teaching/PowerPoint presentations (if needed)</li> <li>2. Regular review of students by asking questions based on topics covered in the class.</li> <li>3. Compliment the understanding by discussing case studies with use of softwares</li> </ol>
<b>Course outcomes:</b> On completion of this course, <ul style="list-style-type: none"> <li>• Understand construction planning and scheduling techniques.</li> <li>• Analyze economic feasibility of highway projects.</li> <li>• Develop skills in project management and monitoring.</li> <li>• Students would be able to prepare highway plans, Land use planning and development models.</li> <li>• They will be able to carry out economic and financial analysis of highway projects.</li> <li>• Understand the highway planning process and difficulties or failures associated with planning process.</li> <li>• Understands the cost of materials, man power and equipment in budget preparations for highway projects.</li> <li>• Analyse the various tasks involved in a road project and sequence them for effective and optimum outcome using tools like CPM and PERT.</li> </ul>	
<b>Graduate Attributes</b> <ul style="list-style-type: none"> <li>• <i>Engineering Knowledge.</i></li> <li>• <i>Problem Analysis.</i></li> <li>• <i>Critical thinking</i></li> <li>• <i>Interpretation of data.</i></li> </ul>	
<b>Assessment Details (both CIE and SEE)</b> The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. <p><b>Continuous Internal Evaluation:</b></p> <ul style="list-style-type: none"> <li>• Two Unit Tests each of <b>25 Marks</b></li> <li>• Two assignments each of <b>25 Marks</b> or <b>one Skill Development Activity of 50 marks</b></li> </ul> to attain the COs and POs The sum of three tests, two assignments/skill Development Activities, will be <b>scaled down to 50 marks</b> <b>CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b> <p><b>Semester-End Examination:</b></p> <ul style="list-style-type: none"> <li>• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.</li> <li>• The question paper will have ten full questions carrying equal marks.</li> <li>• Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.</li> <li>• Each full question will have a sub-question covering all the topics under a module.</li> <li>• The students will have to answer five full questions, selecting one full question from each module</li> <li>• .</li> </ul>	

**Text Books:**

1. L.R. Kadiyali "Traffic Engineering and Transport Planning"-Khanna Publishers, New Delhi.
2. K.K. Chitkara. "Construction Project Management Planning, Scheduling and Controlling"- Tata McGraw Hill publications
3. Winfrey, "Economic analysis for Highways", International Textbook Company, Pennsylvania,1969
4. Dr. Vinay Maitri and Dr. P.K. Sarkar "Theory and Applications of Economics in Highway & Transport Planning" Standard Publishers Distributors, Delhi

**Reference Books:**

1. Prasanna Chandra "Financial Management"-Tata McGraw, New Delhi.
2. Woods K.B, Berry, D.S. and Goetz W.H, "Highway Engineering"-McGraw Hill Book Co.
3. Hewes C.I. and Oglesby, C.H., "Highway Engineering"-Asia Publishing House.
4. Ian G. Heggie, "Transportation Engineering Economics"-McGraw Hill Book Co.
5. "Road User Cost Study in India"- Final Report, Central Road Research Institute, New Delhi, 1982.
6. L.R. Kadiyali, et al, "Value of Travel Time Savings" - Traffic Engineering, HRB
7. Ministry of Road Transport and Highways, "Road Development Plan for India"- 2001-2021, Indian Roads Congress, New Delhi, 2002.
8. IRC "A Manual for the Application of Critical Path Method to Highway Projects in India"
9. Nhai.org, pmgsy.nic.in websites

**Standard Data Book on Highway Technology issued by the University may be referred in the PG Examination of VTU.**

**Skill Development Activities Suggested**

1. Case Study Analysis: Analyze real-life construction projects, identifying challenges and successes.
2. Cost Estimation Exercise: Estimate costs for a hypothetical project using various methods.
3. Scheduling Exercise: Create a project schedule using Gantt charts or CPM.
4. Financial Analysis: Conduct financial analysis for a construction project.
5. Research Paper: Write a research paper on a construction management or economics topic

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No	Description	Blooms Level
CO1	Understand construction planning and scheduling techniques.	L2
CO2	Analyze economic feasibility of highway projects.	L4
CO3	Develop skills in project management and monitoring.	L5
CO4	Students would be able to prepare highway plans, Land use planning and development models.	L1, L3
CO5	They will be able to carry out economic and financial analysis of highway projects.	L4
CO6	Understand the highway planning process and difficulties or failures associated with planning process.	L2
CO7	Understands the cost of materials, man power and equipment in budget preparations for highway projects.	L2
CO8	Analyse the various tasks involved in a road project and sequence them for effective and optimum outcome using tools like CPM and PERT.	L4

**Program Outcome of this course** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Prepare comprehensive construction plans and schedules.	PO1
2	Analyze construction methods and strategies for highway projects.	PO2
3	Develop resource allocation plans and monitor construction progress.	PO3
4	Evaluate economic viability of highway projects.	PO4
5	Analyze costs and benefits of highway projects.	PO5
6	Apply financial analysis techniques for project appraisal.	PO6
7	Analyze complex construction planning and economic problems and Develop and evaluate alternative solutions.	PO7
8	Collaborate with multidisciplinary teams and Prepare and present technical reports and proposals.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X					X	X	X
CO2	X	X	X					X	X
CO3	X	X	X	X		X			
CO4	X	X	X		X	X			
CO5	X	X	X			X	X		X
CO6	X	X	X				X	X	
CO7	X		X	X				X	X
CO8	X	X	X		X	X			



## Semester- 2

TRAFFIC ENGINEERING AND MANAGEMENT (PEC)			
Course Code	MCHT215A	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>Analyze the factors affecting performance of road traffic and the various traffic studies needed for the analysis of traffic flow.</li> <li>Evaluate level of service and capacity of roadways and intersections using traffic data.</li> <li>Propose and design suitable traffic regulatory system based on traffic requirements such as signs, signals, markings, etc.</li> <li>Analyze and design intersections at-grade and grade separated types for smooth and safe movement of vehicles.</li> <li>Propose parking facilities, pedestrian facilities and general safety measures required for highways and expressways.</li> </ul>			
<b>MODULE-1</b>			
<p><b>Traffic Studies &amp; Analysis:</b> Scope, traffic elements - Characteristics-vehicle, road user: and road - Traffic studies-speed &amp; delay, traffic volume, O &amp; D, parking and accidents - Sample size, study methodology - Data analysis &amp; inferences.</p> <p><b>Traffic Forecast</b> – objects, factors governing traffic growth, estimation of traffic growth from past trends, econometric models. Common methods of traffic forecast, Problems.</p>			
Teaching- Learning Process	<ol style="list-style-type: none"> <li>1. Blackboard teaching/PowerPoint presentations (if needed)</li> <li>2. Regular review of students by asking questions based on topics covered in the class.</li> <li>3. Engage in conduction of traffic surveys and reporting</li> </ol>		
<b>MODULE-2</b>			
<p><b>Traffic Flow Analysis:</b> Macroscopic, Microscopic &amp; Mesoscopic approach – Types of Flow- Traffic stream characteristics – Space – Time diagram – Relationship between speed, flow &amp; density-Level of service &amp; capacity analysis – Shockwave theory. <b>Introduction to Queuing theory:</b> vehicle arrivals, delays at intersections, -Problem</p>			
Teaching- Learning Process	<ol style="list-style-type: none"> <li>1. Blackboard teaching/PowerPoint presentations (if needed)</li> <li>2. Regular review of students by asking questions based on topics covered in the class.</li> </ol>		
<b>MODULE-3</b>			
<p><b>Intersection Design:</b> Types of intersections - Conflict diagrams –Control hierarchy- Design of rotaries &amp; at-grade intersections – Signal design - Grade separated intersections &amp; their warrants.</p>			
Teaching- Learning Process	<ol style="list-style-type: none"> <li>1. Blackboard teaching/PowerPoint presentations (if needed)</li> <li>2. Regular review of students by asking questions based on topics covered in the class.</li> </ol>		
<b>MODULE-4</b>			
<p><b>Road Safety Audit:</b> Global &amp; Local perspective – Road safety issues – Road safety programs – Types of RSA, planning, design, construction &amp; operation stage audits – Methodology – Road safety audit measures</p>			
Teaching- Learning Process	<ol style="list-style-type: none"> <li>1. Blackboard teaching/PowerPoint presentations (if needed)</li> <li>2. Regular review of students by asking questions based on topics covered in the class.</li> </ol>		
<b>MODULE 5</b>			
<p><b>Traffic Regulation &amp; Traffic Safety Management:</b> Speed, vehicle, parking, enforcement regulations - Mixed traffic regulation - Management techniques, one-way, tidal flow, turning restrictions etc. – Transportation System Management Process – TSM planning &amp; Strategies</p>			
<p><b>Use of software:</b> PTV VISSIM / VISUM (Traffic Flow Simulations), SIDRA (intersections), etc.</p>			
Teaching Learning Process	<ol style="list-style-type: none"> <li>1. Blackboard teaching/PowerPoint presentations (if needed)</li> <li>2. Regular review of students by asking questions based on topics covered in the class.</li> <li>3. Practice sessions and hands on experience using traffic software</li> </ol>		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

1.

**Suggested Learning Resources:****Text Books:**

1. Kadiyali L.R. "Traffic Engineering and constru" -Khanna Publication, New Delhi
2. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning

**Reference Books**

1. Salter RJ and Hounsell NB, "Highway, Traffic Analysis and Design"- Macmillan Press Ltd., London.
2. Matson T M, Smith W S, Hurd F W, "Traffic Engineering, Mc graw Hill Book Co, NY, USA.
3. Drew D R," Traffic Flow Theory and Control", McGraw Hill Book Co, NY, USA.
4. Wohl and Martin, "Traffic System Analysis of Engineers and Planners"-Mcgraw Hill Book Co, New York, USA.
5. May, A.D., *Traffic Flow Fundamentals*, Prentice – Hall, Inc., New Jersey,1990.
6. O'Flaherty C A, *Highways- Traffic Planning & Engineering*, Edward Arnold,UK
7. Pignataro, "Traffic Engineering", John wiley & sons. Nicholas J Garber, Lester A Hoel, "Traffic & Highway Engineering"- Third edition,
8. IRC: SP 43 1994 and other Relevant IRC codes
9. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10<sup>th</sup> Edition.
10. Indian Highway Capacity Manual (Indo-HCM) CSIR, New Delhi, 2012-2017

**Web links and Video Lectures (e-Resources):**

- (1) <https://archive.nptel.ac.in/courses/105/105/105105107/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- (2) Conduction of the various traffic studies
- (3) Computational procedures for safety effectiveness
- (4) Interpretation of traffic studies

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No	Description	Blooms Level
CO1	Gets the knowledge of factors affecting performance of road traffic and also the traffic studies needed for the analysis.	L2
CO2	Evaluate level of service and capacity of roadways and intersections.	L5
CO3	Propose and design suitable traffic regulatory system such as signs, signals, markings, etc.	L4
CO4	Analyse and design intersections at-grade and grade separated types for smooth and safe movement of vehicles.	L4
CO5	Propose parking facilities, pedestrian facilities and general safety measures required for highways and Expressways.	L3

<b>Program Outcome of this course</b> After successful completion of the program, the post graduates will be able to		
<b>Sl. No.</b>	<b>Description</b>	<b>POs</b>
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>
<b>CO1</b>	X			X	X	X			
<b>CO2</b>	X	X	X	X		X			X
<b>CO3</b>	X		X	X	X				
<b>CO4</b>	X	X	X	X		X			
<b>CO5</b>	X	X	X	X	X				

## Semester- 2

ROAD SAFETY ENGINEERING AND MANAGEMENT (PEC)			
Course Code	MCHT215B	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>Analyze the effect of driver characteristics, roadway characteristics, and climatic factors on highway safety.</li> <li>Plan and design a road safety improvement program.</li> <li>Analyze accident data and suggest safety measures.</li> <li>Conduct road safety audit.</li> <li>Interpret accident data using statistical analysis.</li> </ul>			
<b>Module-1</b>			
<p>Highway Safety in India: traffic crashes on Indian highways, traffic on national highways and state highways, safety on national highways. Introduction to safety: Road accidents, Trends, causes, Collision and Condition diagrams, Highway safety, human factors, Vehicle factors Road Safety Management System: Multi-causal dynamic systems approach to safety, crash vs accident, road safety improvement strategies, elements of a road safety plan, Safety Data Needs.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving		
<b>Module-2</b>			
<p>Statistical Interpretation and Analysis of Crash Data: Before-after methods in crash analysis, Advanced statistical methods, Black Spot Identification &amp; Investigations, Case Studies. Urban Safety and Mobility, Traffic Calming.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, case studies		
<b>Module-3</b>			
<p>Road Safety Audits: Key elements of a road safety audit, Road Safety Audits &amp; Investigations, Crash investigation and analysis, describe methods for identifying hazardous road locations, Vulnerable Road Users, Case Studies.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving		
<b>Module-4</b>			
<p>Crash Reconstruction: Describe the basic information that can be obtained from the roadway surface, understand basic physics related to crash reconstruction, speed for various skid, friction, drag, and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes, Case Studies.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, case studies		
<b>Module-5</b>			
<p>Mitigation Measures: Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry and safety. Road safety management, road safety policy-making, stakeholders involved, developing the road safety management system, capacity building.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, case studies		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. V.F. Babkov "Road Conditions and Traffic Safety", Mir Publishers.
2. Pignataro, "Traffic Engineering", John Wiley & Sons.
3. Nicholas J Garber, Lester A Hoel, "Traffic & Highway Engineering"- Third edition, Thompson Learning
4. Ogden, K.W. Safer Roads: A Guide to Road Safety Engineering. Avebury Technical, 1996.
5. Martin Belcher, Steve Proctor and Phil Cook, Practical Road Safety Auditing, Third edition, ICE Publications, 2015
6. Gitam Tiwari, Dinesh Mohan, "Transport Planning and Traffic Safety-making cities, roads & vehicles safer", Published by CRC Press, ISBN-9781498751452

**Reference Books:**

1. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997
2. (reprinted 2002)
3. Institute of Transportation Engineers (ITE), The Traffic Safety Toolbox: A Primer on Traffic Safety, ITE, 1999.
4. J. Stannard Baker, Traffic Collision Investigation, Northwestern University Center for Public Safety, 2002.
5. Leonard Evans, Traffic Safety, Science Serving Society, 2004.
6. Lynn B. Fricke, Traffic Accident Reconstruction, Northwestern University Center for Public Safety, 1990.
7. Popkess C.A, Traffic Control and Road Accident Prevention, Chapman and Hall, 1997
8. Rune Elvik and Truls Vaa, The Handbook of Road Safety Measures, Elsevier, 2004.
9. Simon Washington, Matthew Karlaftis, and Fred Mannering, Statistical and Econometric Methods for Transportation Data Analysis, Chapman & Hall/CRC Press, 2003.
10. Towards Safe Roads in Developing country, TRL – ODA, 2004.

**Web links and Video Lectures (e-Resources):**

- <https://www.icevirtuallibrary.com/isbn/9780727760166>
- <https://www.routledge.com/Transport-Planning-and-Traffic-Safety-Making-Cities-Roads-and-Vehicles/Tiwari-Mohan/p/book/9781498751452>
- <https://www.amazon.in/Highway-Design-Traffic-Engineering-Handbook/dp/0070382956>

**Skill Development Activities Suggested**

- Conduct a Road safety audit for a given stretch of SH/NH or rural roads
- Participate / conduct in safety awareness campaigns
- Conduct road safety signage audit for a project stretch and give recommendations.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Analyze the effect of driver characteristics, roadway characteristics, and climatic factors on highway safety.	L1, L2, L3
CO2	Plan and design a road safety improvement program.	L1, L2, L3
CO3	Analyze accident data and suggest safety measures.	L4, L5
CO4	Conduct road safety audit.	L2, L3, L4, L5
CO5	Interpret accident data using statistical analysis.	L4, L5

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X								
CO2		X							
CO3					X	X			
CO4					X	X			
CO5					X	X			

## Semester- 2

SOIL MECHANICS (PEC)			
Course Code	MCHT215C/MCEM215C	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>Understand the properties and behavior as a highway material under the application of wheelloads.</li> <li>Understand and compare the shear strength of soil and stability of slopes when used as subgrade soil and embankment fills or cut slopes</li> <li>Understand the permeability characteristics of soils to design proper drainage system and various investigations required to assess the soil properties.</li> <li>Understand the type and soil composition affecting the surface runoff and sub-surface water flow in order to design proper drainage system.</li> <li>Analyse lack of strength or instability problems in soils due to soil formation or any other reasons and propose suitable strengthening methods for the same.</li> </ul>			
<b>Module-1</b>			
<p><b>Introduction:</b> Soil Mechanics applications to Highway / Infrastructure Engineering. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems on these.</p> <p><b>Soil Compaction:</b> Introduction, Lab Tests, Factors affecting, Structure &amp; Engineering behaviour of compacted cohesive soil, Field compaction specifications, Field compaction control, Different types of Equipment used for compaction, their choice.</p>			
Teaching- Learning Process	Black board, LCD, data collection through field/site investigation, lab demonstration on certain experiments on properties of soil		
<b>Module-2</b>			
<p><b>Shear strength of soil:</b> Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil Tangent, Secant modulus, Stress – Strain curves, Poisson’s ratio, Shear Modulus.</p> <p><b>Stability of slopes:</b> Introduction, Types, Different methods of analysis of slopes for <math>\phi u+0</math> &amp; <math>C-\phi</math> soil, Location of most critical circle, Earth dam slopes stability, Taylor’s stability number. Effect of Earthquake Force, problems on above.</p>			
Teaching- Learning Process	Black board, LCD, data collection through field/site investigation,		
<b>Module-3</b>			
<p><b>Permeability of soil:</b> Darcy’s Law, Validity, Soil-water system, Types, Determination of permeability, problems.</p> <p><b>Site Investigation:</b> Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.</p>			
Teaching- Learning Process	Black board, LCD, data collection through field/site investigation, application of modern equipment’s for field studies and laboratory studies		
<b>Module-4</b>			
<p><b>Special attention for subgrade condition:</b> Problematic soils, compressible &amp; collapsible soils, swelling, subsurface water, frost-susceptible soils.</p> <p><b>Surface drainage,</b> Sub-surface drainage, methods, Design of subsurface drainage system, soil stabilization, soil encapsulation. Base layer requirement-erodibility of bases, bound bases, modified or treated bases, base reinforcement</p>			
Teaching- Learning Process	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation, application of modern equipment’s for field studies and laboratory studies		
<b>Module-5</b>			
<p><b>Reinforced Earth structures</b> Introduction, Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses. Landslides – definition, classifies, factors producing.</p>			
Teaching- Learning Process	Black board, LCD, laboratory studies.		



**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age International Publishers.
2. "Soil Mechanics & Foundation Engg", Dr.B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 16<sup>th</sup> edition.
3. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10<sup>th</sup> Edition.

**Reference Books:**

1. "Geotechnical aspects of pavement reference manual", US department of transportation, Publication no: FHWA NHI-05-037, Federal Highway Administration, May 2006, NHI course no:132040
2. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard Publishers Distributors.
3. "Soil Mechanics for road Engineers" – HMSO, London.  
IRC – Relevant Codes.

**Web links and Video Lectures (e-Resources):**

- <https://youtu.be/V1m3cB-Aqy8>
- [https://youtu.be/ldNt\\_O1obPQ](https://youtu.be/ldNt_O1obPQ)
- <https://nptel.ac.in/courses/105103097>

**Skill Development Activities Suggested**

- Data collection through site investigation
- Carrying out field tests and laboratory tests

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms
CO1	Able to understand different types of soil and their basic properties, analyse the wheelload effects on pavement materials	L1, L2, L
CO2	Evaluate and compare the shear strength of soil and stability of slopes when used as pavement component.	L1, L2, L
CO3	Design proper drainage system by knowing the permeability characteristics of soils.	L1, L2, L
CO4	Design surface runoff and sub-surface drainage system as per field conditions.	L1, L2
CO5	Propose suitable strengthening methods for soil from the knowledge of lack of strength or instability in soils	L2, L3

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl.No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X		X			X	X	X	X
CO2	X		X		X	X	X		X
CO3	X	X	X		X	X			X
CO4	X	X	X		X	X			
CO5	X		X		X	X	X		X

## Semester- 2

<b>CONSTRUCTION &amp; DEMOLITION WASTE MANAGEMENT (PEC)</b>			
Course Code	<b>MCHT215D/MCEM215D</b>	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>• Focus on the principles of sustainable construction and demolition waste management and resource efficiency</li> <li>• Examining the environmental impact of building materials.</li> <li>• Formulating and designing pre-construction and site waste management plans</li> </ul>			
<b>Module-1</b>			
Environmental Impact of Building Materials Embodied energy of materials; impact on the local environment; toxicity of the material; life cycle assessment. Nature and Source Direct and indirect waste; site types and origins; composition; quantity; current recycling/reuse potential of building materials.			
<b>Teaching- Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-2</b>			
Construction and Demolition Waste Management Plans International good practice; planning requirements; DoEHLG guidance document; company policy; demolition plans; site implementation; supplier agreements; sub-contractor management; role of waste management contractor; training; auditing; skip management; current markets; current disposal options; health and safety; reporting to local authorities. Treatment of Construction and Demolition Waste, waste permits; waste licenses; waste transfer facilities; landfills; treatment technologies; hazardous waste facilities; reporting to EPA			
<b>Teaching- Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-3</b>			
Designing for Waste Prevention and Minimization, Waste prevention and minimization; client, contractor and designer attitudes; proper maintenance of existing buildings; reuse of existing building structure; design flexibility; design for reuse and recycling; dimensional co-ordination and standardization; modular design; material selection and control.			
<b>Teaching- Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-4</b>			
Waste Forecasting Tools Application of WRAP's designing out waste tool for buildings and civil engineering; WRAP net waste tool; BRE SMART Waste; WRAP Site Waste Management Plan Tracker.			
<b>Teaching- Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-5</b>			
Future developments Potential future markets; 'smart' materials; use of eco-materials.			
<b>Teaching- Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. "Basic and Applied soil Mechanics", Gopal Ranjan, ASR Rao, New Age International Publishers.
2. "Soil Mechanics & Foundation Engg", Dr.B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 16<sup>th</sup> edition.
3. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10<sup>th</sup> Edition.

**Reference Books:**

1. "Geotechnical aspects of pavement reference manual", US department of transportation, Publication no: FHWA NHI-05-037, Federal Highway Administration, May 2006, NHI course no:132040
2. "Soil Mechanics & Foundation Engg" – K.R. Arora Standard Publishers Distributors.
3. "Soil Mechanics for road Engineers" – HMSO, London.

**Web links and Video Lectures (e-Resources):**

- <http://www.digimat.in/nptel/courses/video/105105160/L48.html>

**Skill Development Activities Suggested**

- Visit to Recycle plants.
- Studies of International standards on waste management

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	They can able to understand the basic concept of embodied energy of construction materials.	L2, L3, L4
CO2	Understand the application of construction and demolition waste to various concrete structures	L3, L4

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1			X						
CO2			X	X					

## Semester- 2

SPECIAL CONCRETES (PEC)			
Course Code	MCHT215E/MCEM215E	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>To understand the factors affecting pavement design and performance of Rural Roads.</li> <li>To relate the concepts of Highway Geometric design to that of Rural roads</li> <li>To design the Special pavements which form alternatives for Rural Roads.</li> <li>To understand the concepts of design of drainage, CD works and small bridges which form essential structures of Rural roads</li> </ul>			
<b>Module-1</b>			
Salient features of concrete mix design as per Indian standard (IS: 10262:2019). High Strength Concrete: Definition, Mix Proportioning as per IS 10262-2019, Properties and Applications. SDA: Preparation of design spreadsheets of different Concrete Mixes.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, case studies		
<b>Module-2</b>			
Light Weight Concrete: Introduction, Definition, types, Properties and Applications. Geo-polymer Concrete: Brief history of development, Definition, material characterization, mix proportioning, properties, and applications. SDA: Characterization of light weight and geo-polymer concrete / blocks			
<b>Teaching- Learning Process</b>	. Black board, LCD, Skill enhancement through problem solving, case studies		
<b>Module-3</b>			
Self-compacting concrete: Introduction, Materials, Mix design of SCC as per IS 10262-2019, Fresh Properties of SCC - Filling, Passing and Segregation resistance, Hardened Properties of SCC – Compressive strength, Production and transportation, Placement and SCC application. SDA: Group activity - Developing SCC mixes by other than IS method.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, case studies		
<b>Module-4</b>			
Fiber-reinforced Concrete: Brief Introduction on FRC, Properties of fibers and matrices, Theoretical stress–strain curves in uniaxial tension, Fresh concrete and Hardened concrete, Applications. Roller Compacted Concrete: Introduction, Materials, Mix design as per IS 10262-2019, Fresh and Hardened Properties of mass concrete. SDA: Group activity - Application of the fibers in construction materials.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, case studies		
<b>Module-5</b>			
Recycled concrete: Introduction, Properties of recycled aggregate, Methods of recycling and quality, Applications. CLSM: Brief Introduction, Materials and Properties as per ACI 229R, Applications. SDA: Group activity – Develop concrete for low strength applications using un-conventional and recycled materials			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, case studies		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. A. M. Neville, Properties of Concrete, Pearson Education (Singapore) Pvt.Ltd.
2. P. Kumar Mehta and Paulo J. M. Monteiro, "Concrete Microstructure, Properties, and Materials"-McGraw Hill Education

**References:**

1. John Newman and Ban Seng Choo, Advanced Concrete Technology, ISBN 0 7506 5105 9, Elsevier Ltd.
2. Concrete Construction Engineering Handbook by Dr. Edward G. Nawy, CPC Press, 2nd Edition, ISBN 9780849374920.
3. Joseph A. Daczko, Self-Compacted Concrete by-Appling what we know, CPC Press, ISBN-13: 978- 0 203-84422-9

**Web links and Video Lectures (e-Resources):**

- [https://onlinecourses.nptel.ac.in/noc22\\_ce09/preview](https://onlinecourses.nptel.ac.in/noc22_ce09/preview)

**Skill Development Activities Suggested**

- Visit to RMC Plants
- Conduct tests on various type of concrete mixes

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Identify ingredient of concrete material characteristics and different types of concrete for their appropriate use in construction.	L2, L3
CO2	Design special concrete mixes like Self-compacted concrete and Geo-polymer	L3, L4
CO3	Concrete mixes and asses the fresh and hardened properties using various guidelines.	L2, L3, L4
CO4	Determine the compressive strength of concrete structures by Non-Destructive Methods.	L3, L4

<b>Program Outcome of this course:</b> After successful completion of the program, the post graduates will be able to		
<b>Sl. No.</b>	<b>Description</b>	<b>POs</b>
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>
<b>CO1</b>			X						
<b>CO2</b>				X	X	X			
<b>CO3</b>	X					X			
<b>CO4</b>			X	X					



## Semester- 2

<b>BRIDGE AND GRADE SEPARATED STRUCTURES (PEC)</b>			
Course Code	MCHT216A/MCEM216A	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>• Understand historical evolution of bridges and types of bridges.</li> <li>• Understand the elements of bridge design i.e., forces on bridges, IRC loading standards for road and railway bridges.</li> <li>• Know in detail about flyovers, their types and related IRC code provisions on geometrical designs.</li> <li>• Understand substructures, piers, abutments, and appurtenances.</li> <li>• Explain the quality assurance, bridge inspection and health monitoring</li> </ul>			
<b>Module-1</b>			
Historical evolution of bridges, classification of bridges, conceptual bridge design, site investigation, preliminary data to be collected, preliminary drawings, economic span of a bridge, ideal bridge, location of piers and abutments, traffic projection, investigation report, importance of proper investigation.			
<b>Teaching-Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-2</b>			
Standard specifications for road bridges, clearances, loads to be considered, dead load, IRC standard live loads, other type of loads. General design considerations, minimum reinforcement in beams and slabs, concreting operations, pre-stressed concrete, notations for detailing concrete bridges, traffic aspects of highway bridges, aesthetics of bridges, relative costs of bridge components.			
<b>Teaching-Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-3</b>			
Flyovers, differences between flyovers and bridges, necessity for flyovers, types of flyovers: over pass, trumpet type, diamond shaped, cloverleaf shaped, rotary type, and directional advantages and disadvantages of each. Factors to be considered while building a flyover. Geometric design features, land requirement, spacing, design vehicle, ramps, typical pier and abutment dimensions. Concepts of congestion factor and reduction factors. Landscaping of flyovers.			
<b>Teaching-Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-4</b>			
Bridge substructures, Piers, abutments, foundation types. Bridge bearings, joints and appurtenances, functions rendered by bearings, types of bearings, expansion bearing, fixed bearing, elastomeric pot bearings, bearings for skew bridges, joints, expansion joints, appurtenances, foot paths, hand rails, drainage arrangements, wearing course, approach slab. Relevant IRC standards.			
<b>Teaching-Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		
<b>Module-5</b>			
Construction of bridges, quality assurance of bridge projects, bridge construction inspection- data to be collected. Construction of short span and long span bridges. Construction of continuous concrete bridges. Formwork and false work for concrete bridges, numbering of bridges, bridge management system. Smart structural health monitoring (SSHM) of bridges. Components of SSHM. Types of monitoring and metrics of monitoring. IoT in bridge health monitoring.			
<b>Teaching-Learning Process</b>	Blackboard teaching/PowerPoint presentations (if needed)		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. D.Johnson Victor, "Essentials of bridge Engineering"- Oxford, IBH publishing company.
2. Ponnuswamy, "Bridge Engineering"-McGraw Hill Publication, 1989.

**Reference Books:**

1. Relevant IRC codes
2. Vazirani Ratwani & M.G.Aswani, "Design of Concrete Bridges"- Khanna Publishers, New Delhi
3. "Design of Bridges"- Dr. Krishna Raju, Oxford & IBH Publishing Company Limited.  
"Analysis and design of Bridges"- M.A.Jayaram, Sapna Publishers, Bangalore.

**Web links and Video Lectures (e-Resources):**

- [https://onlinecourses.nptel.ac.in/noc22\\_ce63/preview](https://onlinecourses.nptel.ac.in/noc22_ce63/preview)

**Skill Development Activities Suggested**

- Visual inspection of the grade separated structures.
- Construction Site visit

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Elaborate on conceptual bridge design, identify suitable bridge for a given scenario, and be able to prepare a suitable report upon doing site investigation.	L1, L2, L3
CO2	Demonstrate the knowledge on bridge loading standards and IRC-code provisions.	L1, L2, L3
CO3	Identify different types of flyovers and recommend particular type depending on the constraints.	L2, L3, L4
CO4	Differentiate between different types of bearings and recommend a suitable type of bearing.	L2, L3, L4
CO5	Explain construction methods for different types of bridges, and able to decide on suitable health Monitoring procedure	L2, L3, L4, L5

12-08-2024/25

<b>Program Outcome of this course:</b> After successful completion of the program, the post graduates will be able to		
<b>Sl. No.</b>	<b>Description</b>	<b>POs</b>
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	Possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

  

<b>Mapping of COS and POs</b>									
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>
<b>CO1</b>	X								
<b>CO2</b>	X	X							
<b>CO3</b>	X								
<b>CO4</b>	X								
<b>CO5</b>	X					X			

**Semester- 2**

<b>SMART CITY INFRASTRUCTURE (PEC)</b>			
Course Code	MCHT216B/MCEM216B	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	03	Exam Hours	3
<b>Course Learning objectives:</b>			
<ul style="list-style-type: none"> <li>To enable the students to apply the basic need and planning concept to solve various Infrastructure problems.</li> <li>To develop a basic understanding about various types of Infrastructure and Smart city.</li> </ul>			
<b>Module-1</b>			
Fundamental of smart city & Infrastructure: Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city world and India. Need to develop smart city, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, Infrastructures need assessment.			
<b>Module-2</b>			
Planning and development of Smart city Infrastructure: Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management.			
<b>Module-3</b>			
Intelligent transport systems Smart vehicles and fuels, GIS, GPS, Navigation system, traffic safety management, mobility services, E-ticketing.			
<b>Module-4</b>			
Management of water resources and related infrastructure Storage and conveyance system of water, sustainable water and sanitation, sewerage system, flood management, conservation system.			
<b>Module-5</b>			
Infrastructure Management system & Policy for Smart city Integrated infrastructure management systems for smart city, Infrastructure management. system applications for existing smart city. Worldwide policies for smart city Government of India - policy for smart city, Mission statement & guidelines, Smart cities in India, Case studies of smart city.			
<b>Assessment Details (both CIE and SEE)</b>			
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.			
<b>Continuous Internal Evaluation:</b>			
<ul style="list-style-type: none"> <li>Two Unit Tests each of <b>25 Marks</b></li> <li>Two assignments each of <b>25 Marks</b> or <b>one Skill Development Activity of 50 marks</b></li> </ul>			
to attain the COs and POs			
The sum of three tests, two assignments/skill Development Activities, will be <b>scaled down to 50 marks</b>			
<b>CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b>			
<b>Semester-End Examination:</b>			
<ul style="list-style-type: none"> <li>The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.</li> <li>The question paper will have ten full questions carrying equal marks.</li> <li>Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.</li> <li>Each full question will have a sub-question covering all the topics under a module.</li> <li>The students will have to answer five full questions, selecting one full question from each module</li> </ul>			

Suggested Learning Resources:								
<b>Books</b>								
1. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li								
2. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by Nicos Komninos								
3. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony								
4. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997								
5. Mission statement & guidelines on Smart City Scheme". Government of India - Ministry of Urban Development <a href="http://smartcities.gov.in/upload/uploadfiles/files/Smart%20City%20Guidelines%20(1).pdf">http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines (1).pdf</a>								
6. Grig N.S., Infrastructure engineering and management, Wiley-Interseience, 1988								
<b>Web links and Video Lectures (e-Resources):</b>								
1. Smart city government of India. <a href="http://smartcities.gov.in">http://smartcities.gov.in</a>								
2. Reconceptualizing Smart Cities: A Reference Framework for India <a href="https://www.niti.gov.in/writereaddata/files/document_publication/CSTEP%20Report%20Smart%20Cities%20Framework.pdf">https://www.niti.gov.in/writereaddata/files/document_publication/CSTEP%20Report%20Smart%20Cities%20Framework.pdf</a>								
3. Draft Concept Note on Smart City Scheme". Government of India - Ministry of Urban Development - <a href="http://martcitiesoftomorrow.com/wp-content/uploads/2014/09/CONCEPT_NOTE_3.12.2014__REVISED_AND_LATEST_.pdf">martcitiesoftomorrow.com/wp-content/uploads/2014/09/CONCEPT_NOTE_3.12.2014__REVISED_AND_LATEST_.pdf</a>								
<b>Skill Development Activities Suggested</b>								
<ul style="list-style-type: none"> <li>• Student seminars on related topics that is beyond syllabus.</li> <li>• Discussion with experts and listening to expert lectures.</li> <li>• Field visits and making reports on the learnings.</li> </ul>								
<b>Course outcome (Course Skill Set)</b>								
At the end of the course, the student will be able to:								
Sl. No.	Description							Blooms Level
CO1	Understand the necessity of infrastructural development for smart cities.							L2
CO2	Identify components of infrastructure and Prepare infrastructure plan for smart city.							L2 & L3
CO3	Understand smart transport system for smart cities and its application							L3
CO4	Study of water resources systems for smart city and its application.							L2
CO5	Understand National and Global policies to implement for smart city development							L2
<b>Mapping of COS and POs</b>								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X							
CO2	X		X					
CO3	X		X					
CO4	X	X						
CO5	X		X					

## Semester- 2

URBAN PUBLIC TRANSPORT (PEC)			
Course Code	MCHT216C	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>• Understand the various options for urban public transportation and recommend suitable mode for the given situation.</li> <li>• Conduct economic analysis between different transport modes and suggest most economical and efficient mode under the given set of conditions.</li> <li>• Understand the management of public transport system and developing strategies for efficient functioning of the system.</li> <li>• Carry out the evaluation of capacities of the system parameters such as routes, junctions, stations etc., to know the performance of the system.</li> <li>• Forecast the future transportation needs and variations in system components so as to plan for the transportation system requirements.</li> </ul>			
<b>Module-1</b>			
<p><b>System and Technologies:</b> Urban passenger transportation modes, transit classifications and definitions, theory of urban passenger transport modes, rail transit, bus transit, Metro and Mono Rail, Para transit and ride sharing, designing for pedestrians, trends in transit rider ship and use of different modes.</p>			
Teaching- Learning Process	Black board, LCD, Skill enhancement through problem solving, field studies		
<b>Module-2</b>			
<p><b>Comparing Alternatives:</b> Comparing costs, comparative analysis, operational and Technological characteristics of different rapid transit modes, evaluating rapid transit, Problems.</p>			
Teaching- Learning Process	Black board, LCD, Skill enhancement through problem solving		
<b>Module-3</b>			
<p><b>Planning:</b> Transportation system management, system and service planning, financing public transportation, management of public transportation, public Transportation marketing.</p>			
Teaching- Learning Process	Black board, LCD, Skill, enhancement through problem solving, case studies		
<b>Module-4</b>			
<p><b>Transit System Evaluation:</b> Definition of quantitative performance attributes, transit lane capacity, way capacity, station capacity, theoretical and practical Capacities of major transit modes, quantification of performance, Problems.</p>			
Teaching- Learning Process	Black board, LCD, Skill enhancement through problem solving		
<b>Module-5</b>			
<p><b>Urban traffic:</b> Classification of transportation systems, conventional transportation systems, non-conventional transportation systems, prototypes and tomorrow's solutions, analysis and interpretation of information on transportation systems, perspectives of future transportation.</p>			
Teaching- Learning Process	Black board, LCD, Skill enhancement through problem solving		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. George E. Gray and Lester A. Hoel, 'Public Transportation', Prentice Hall, New Jersey.
2. Vukan R. Vuchic, 'Urban Public Transportation Systems and Technology', Prentice Hall Inc., New Jersey.

**Reference Books:**

1. Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss, 'City Traffic - A Systems Digest', Van Nostrand Reinhold Company, New York
- John W. Dickey, 'Metropolitan Transportation Planning', Tata McGraw-Hill Publishing Co. New Delhi.

**Web links and Video Lectures (e-Resources):**

- <https://dult.karnataka.gov.in/en>
- <https://archive.nptel.ac.in/courses/105/107/105107067/>

**Skill Development Activities Suggested**

- work on case studies
- Formulate the Parking Action Plan for a study area
- Visit to Multimodal Integration of Traffic and Transit Management Centre (TTMC) and understand their activities.
- Mini projects on efficiency of public transport system in urban areas.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Understand the various options for urban public transportation and recommend suitable mode for the given situation.	L1, L2
CO2	Conduct economic analysis between different transport modes and suggest most L3 economical and efficient mode under the given set of conditions.	L2
CO3	Understand the management of public transport system and developing strategies for efficient functioning of the system	L4
CO5	Carry out the evaluation of capacities of the system parameters such as routes, junctions, stations etc., to know the performance of the system.	L2, L3, L4
CO6	Forecast the future transportation needs and variations in system components so as to plan for the transportation system requirements.	L4



**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X								
CO2					X	X			
CO3					X				
CO4						X			
CO5					X	X			

## Semester- 2

LOW VOLUME ROADS ENGINEERING (PEC)			
Course Code	MCHT216D	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<b>Course Learning objectives:</b> This course will enable students to <ul style="list-style-type: none"> <li>To understand the factors affecting pavement design and performance of Rural Roads.</li> <li>To relate the concepts of Highway Geometric design to that of Rural roads</li> <li>To design the Special pavements which form alternatives for Rural Roads.</li> <li>To understand the concepts of design of drainage, CD works and small bridges which form essential structures of Rural roads</li> </ul>			
<b>Module-1</b>			
Introduction to Low-Volume Roads (LVR). Significance of LVR, Definition, Design Environments. Planning of rural road, planning data base, concept of network planning Rural roads plan, guidelines laid down in recent 20-year plans and in PMGSY Road alignment and surveys, governing factors for route selection Factors controlling alignment; obligatory points, traffic, geometric designs, economy, special considerations in hilly areas.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation.		
<b>Module-2</b>			
Geometric design standards: classification of rural roads, terrain classification, design speed, basic principles of geometric design cross sectional elements, camber, sight distances Horizontal alignment: general guidelines, super elevation, transition curve, widening and set back distances, vertical alignment: gradient, grade compensation at curves, valley curves, alignment compatibility, lateral and vertical clearances.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation.		
<b>Module-3</b>			
Soil and material surveys, soil investigations for low embankment, high embankment, cut sections, subgrade, Survey for marginal materials and aggregates/ low grade materials Artificial aggregates, waste materials, new materials and stabilizers Design parameters, pavement components Design of flexible pavement: pavement thickness, pavement surfacing Design of semi rigid pavement: dry lean concrete / lime fly ash concrete bases Design of rigid pavement: cement concrete pavement Design of special pavements: concrete block pavement , interlocking concrete block pavement Choice of pavement type and materials, maximize use of Locally available materials, Use of Geo-synthetics in LVR			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation.		
<b>Module-4</b>			
Types of road drainage, requirements of surface drain; roadside drains, shoulder drains, catch water drains. Requirements subsurface drain Cross drains; types, requirements, choice of different types of cross drains Standard designs of culverts Standard design of small bridges.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving		
<b>Module-5</b>			
Selection of materials and methodology, construction techniques, machinery and tools. Construction of Embankment / subgrade; materials, requirements and construction operations. Choice and requirements of coarse sand sub base, gravel roads. Innovative technology for Low volume roads. Pavement Maintenance and Rehabilitation Management System (RMS) for LVR. Unpaved, climate resilience LVR.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation.		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. S.K. Khanna, C.E.G Justo and A. Veeraragavan, "Highway Engineering"- Nem Chand and Bros., Roorkee. Revised 10<sup>th</sup> Edition.
2. Robert A. Douglas, Low-Volume Road Engineering, Design, Construction, and Maintenance, 1 edition, CRC Press

**Reference Books:**

1. IRC: SP:72-2015, Guidelines for the design of Flexible Pavements for Low Volume Roads, First Revision
2. IRC: SP:62-2014, Guidelines for Design & Construction of CC pavements for low volume roads
3. IRC SP 20 Rural Roads Manual
4. Relevant IRC Publications

**Web links and Video Lectures (e-Resources):**

- <http://omms.nic.in/>

**Skill Development Activities Suggested**

- Understand the PMGSY's three-tier Quality Control & Quality Monitoring mechanism.
- Visit nearby roads constructed under PMGSY scheme and evaluate the performance over a period of time.
- Study the various technology demonstration projects executed under PMGSY

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Get the knowledge of factors affecting pavement design and performance of rural roads	L2
CO2	The student will be able to differentiate the design and construction of Low volume rural roads with that of the Highways	L2, L3
CO3	The students will be able to infer and review the DPRs prepared for construction of Rural Roads such under PMGSY	L2, L3, L4

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					X				
CO2			X		X				
CO3		X			X	X			

## Semester- 2

Road Construction Planning and Management (PEC)			
Course Code	MCHT216E	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	3
<b>Course Learning objectives:</b> This course will enable students to <ul style="list-style-type: none"> <li>• Understand the highway planning process and difficulties or failures associated with planning process.</li> <li>• Understands the cost of materials, man power and equipment in budget preparations for highway projects.</li> <li>• Identify suitable equipment and their selection in the production of pavement materials.</li> <li>• Analyse the various tasks involved in a road project and sequence them for effective and optimum outcome using tools like CPM and PERT.</li> <li>• Use the software or management tools to manage the resources, cost and duration of equipment.</li> </ul>			
<b>Module-1</b>			
Various types of highway development projects in progress in India and their scope. Factors to be considered in planning of new highway /expressway / bypass and up- gradation of existing roads.			
<b>Planning of Road Projects</b> –project management framework, scope, project objectives, project environment, causes of project failure, project development process			
Teaching-Learning Process	Black Board, Slides on Projector		
<b>Module-2</b>			
<b>Resource planning</b> – human resources, project man power grouping, structuring site organization, construction materials-classification of construction materials, materials usage, materials inventory, cost and budget			
Teaching-Learning Process	Black Board, Slides on Projector		
<b>Module-3</b>			
Construction equipment and choice-type, capacity and number, task considerations, cost considerations, engineering considerations, equipment acquisition options, optimum location of crushing and mixing plants, problems.			
Teaching-Learning Process	Black Board, Slides on Projector		
<b>Module-4</b>			
<b>Time planning</b> – project work breakdown, determining activities involved, assessment of duration, CPM/PERT network analysis, work scheduling, methods of work scheduling, factors affecting work scheduling, Problems.			
Teaching-Learning Process	Black Board, Slides on Projector		
<b>Module-5</b>			
<b>Planning Control System</b> – resource production, project cost, project time, codification and project management, information system, use of software.			
Teaching-Learning Process	Black Board, Slides on Projector		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

1.

<b>Suggested Learning Resources:</b>		
Reference Books		
<ul style="list-style-type: none"> <li>• K.K. Chitkara. "Construction Project Management Planning, Scheduling and Controlling"- Tata McGraw Hill publications</li> <li>• S.C. Sharma "Construction Equipment and its Management"- Khanna Publishers</li> <li>• Peurifoy / Schexnayder "Construction Planning, Equipment and Methods"-Tata Mc Graw Hill Publications</li> <li>• IRC "A Manual for the Application of Critical Path Method to Highway Projects in India"</li> <li>• Nhai.org, pmsgy.nic.in websites</li> </ul>		
<b>Web links and Video Lectures (e-Resources):</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.cmu.edu/cee/projects/PMbook/09_Construction_Planning.html">https://www.cmu.edu/cee/projects/PMbook/09_Construction_Planning.html</a></li> <li>2. <a href="https://www.coursera.org/courses?query=construction%20project%20management">https://www.coursera.org/courses?query=construction%20project%20management</a></li> </ol>		
<b>Skill Development Activities Suggested</b>		
<ul style="list-style-type: none"> <li>• Analysis of case studies related construction project management</li> <li>• ABC classification</li> <li>• Break even analysis – case study</li> </ul>		
<b>Course outcome (Course Skill Set)</b>		
At the SPEC end of the course the student will be able to:		
Sl. No	Description	Blooms Level
CO1	Understand the highway planning process and difficulties or failures associated with planning process.	L1, L2
CO2	Understands the cost of materials, man power and equipment in budget preparations for highway projects.	L2, L3, L4
CO3	Identify suitable equipment and their selection in the production of pavement materials.	L3, L4
CO4	Analyse the various tasks involved in a road project and sequence them for effective and optimum outcome using tools like CPM and PERT.	L4, L5
CO5	Use the software or management tools to manage the resources, cost and duration of equipment.	L5

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	Possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X							
CO2	X								
CO3			X		X				
CO4				X	X				
CO5		X				X		X	



<b>Pavement materials and Evaluation Laboratory (PCCL)</b>			
Course Code	<b>MCHTL207</b>	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	1:2:0	SEE Marks	50
Credits	2	Exam Hours	03
<b>Course objectives:</b> The objective of this course is to make students learn <ul style="list-style-type: none"> <li>• The procedure and test the basic properties of bitumen and modified binders, learn bituminous mix design</li> <li>• Learn field tests on pavement evaluation</li> </ul>			
<b>Sl.NO</b>	<b>Experiments</b>		
1	<b>Test on Subgrade Soil</b> - Grain size analysis - Wet sieve analysis, Liquid limit, plastic limit & Shrinkage limit, Free Swell Index, Compaction test, Determination of Effective CBR, Unconfined Compression Strength Test, Soil-Cement Mix Design as per IRC: SP:89-2010.		
2	<b>Tests on Road aggregates</b> - Shape tests - Combined Index, Aggregate impact value test, Los Angeles abrasion value test, Specific gravity & Water absorption test, Stripping value test, Polished stone value test, Sand equivalent test.		
3	<b>Tests on cement &amp; concrete</b> - Fineness of Cement, Standard consistency & setting time of cement Soundness, Fresh concrete – workability, Slump test, Compaction Factor test and Flow Table test, Compressive strength of cement, Concrete Mix design Compressive Strength of concrete, Flexural strength of concrete, Concrete Mix design, Compressive Strength of concrete Flexural strength of concrete. DLC & PQC – Fresh and hardened properties		
4	<b>Tests on bitumen / polymer modified binders</b> - Penetration test, Viscosity test, Specific gravity test, Flash and fire point test Ductility and elastic recovery test, Softening point test and separation test, Tests on bitumen Emulsion & Cutback bitumen.		
5	<b>Tests on bituminous mixes</b> - Proportioning of materials by Rothfutch's method and Mix design by Marshall Method		
6	<b>Field Tests on Pavement evaluation</b> - Benkelman Beam deflection studies & analysis, Measurement of Unevenness by Merlin & Bump integrator - Calibration of Bump Integrator, Surface Distress measurements – visual & wind shield survey – Determination of PCI, Non-destructive test on concrete by: (Demonstration) (a) Rebound Hammer Test; (b) Ultrasonic Pulse Velocity Test; (c) Profilometer		
<b>Course outcomes (Course Skill Set):</b> At the end of the course the student will be able to: CO1: Acquired the expertise to conduct various tests on binder, modified binders and bituminous mixes. CO2: Gained knowledge on various field tests for the pavement evaluation			

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute; examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

<b>SPECIAL PROBLEMS IN ROAD CONSTRUCTION</b>			
Course Code	MCHT311	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>Understand the difficulties of road construction in weak and marshy soils and necessary precautions to be taken during design and construction.</li> <li>Understand the methods of strengthening soil fills and embankments to improve their performance as pavement component layer.</li> <li>Understand the difficulties associated with construction of high embankments and maintaining stability of hill slopes with precautions to be taken.</li> <li>Understand the use of recycled materials in road construction including milled bituminous waste with necessary design methodology.</li> <li>Understand the design and construction of roads in coastal and desert environments with exclusive exposure conditions.</li> </ul>			
<b>Module-1</b>			
<p><b>Problems of construction of roads in marshy areas and weak / expansive soils and water-</b> logged - areas. Various effective measures for solving the problems, machinery required and method of construction. Control of water table, capillary rise and seepage flow in road construction. Design and construction of filter drains and capillary cut-off. Construction of subgrade in marshy areas and weak / expansive soils and water- logged - areas.</p>			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies		
<b>Module-2</b>			
<p>Methods of strengthening weak foundation soil, acceleration of consolidation and settlement of compressible embankment foundation, vertical sand drains -Application, design and construction method.</p>			
<b>Teaching- Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving.		
<b>Module-3</b>			
<p>Problems in construction of high embankments, stability of foundation and embankment slopes. Stability of hill slopes, control of erosion.</p>			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies		
<b>Module-4</b>			
<p><b>Use of special materials such as</b> geo-synthetics for drainage and in pavement layers. Use of reinforced earth retaining walls, Nailing Technique, Techniques of pavement construction using recycled materials – cold and hot mix recycling of bituminous materials.</p>			
<b>Teaching- Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies		
<b>Module-5</b>			
<p><b>Special construction techniques</b> - construction techniques of cell filled concrete Pavements – design, economics and construction method, and its application. Road construction on desert region and coastal areas, alternative methods, <b>Special problems</b> in construction &amp; maintenance of hill roads, land slide, causes, investigation, and preventive and remedial measures, protection of embankment and cut slopes.</p>			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving, case studies		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. R.M. Koerner "Designing with Geosynthetics"- 4th Edition Prentice Hall, New Jersey, 1997.
2. Geotechnical Aspects of Pavements Reference Manual / Participant Workbook U.S. Department of Transportation Publication No. FHWA NHI-05-037 Federal Highway Administration May 2006,  
<https://www.fhwa.dot.gov/engineering/geotech/pubs/05037/05037.pdf>
3. Pavement Drainage- Theory and Practice", G.L. Shivakumar Babu, Prithvi S Kandhal, Nivedya Mandankara Kottayi, Rajib Mallick, A. Veeraragavan, CRC Press

**Reference Books:**

1. IRC-75 "Guidelines for the design of High embankments"- IRC, 2015
2. Leonards G.A. "Foundation engineering"- McGraw Hill Book Company, New York, 1962.
3. Cedgreen H.R. "Drainage of highway and airfield pavement"- John Willey and Sons.Inc., New York, 1974.
4. G. Kassiff M. Livnet. G. Wisemen "Pavements on Expansive clays"- Jerusalem Academy Press, Jerusalem. Israel, 1969.
5. R.D. Krebs & R.D.Walker "Highway Materials"- McGraw Hill Book House, New York, 1971.

**Web links and Video Lectures (e-Resources):**

- <https://www.maccaferri.com/in/case-histories/>

**Skill Development Activities Suggested**

- Literature study on real-time case studies of special problems encountered and mitigation.
- Site visits

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Get the knowledge about the difficulties of road construction in weak and marshy soils and the precautions to be taken.	L2, L3
CO2	Suggest improvement methods of strengthening soil fills and embankments to be a pavement layer.	L3, L4
CO3	Know the difficulties associated with construction of high embankments and maintaining hill slopes stability.	L2, L3, L4
CO4	Use recycled materials in road construction with appropriate design methods.	L2, L3
CO5	Provide design and construction methods for roads in coastal and desert environments.	L2, L3, L4

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	X									
CO2				X	X					
CO3					X	X				
CO4				X	X					
CO5				X	X	X				

## Semester- 3

TRANSPORTATION PLANNING			
Course Code	MCHT312	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>Understand the different modes of transportation and factors affecting planning process for an effective transportation system.</li> <li>Understand the characteristics of mass transit system and methods of collecting traffic data to propose an effective transport facility.</li> <li>Understand and sources of zonal trip generation or attraction and then inter-zonal trip distribution methods.</li> <li>Analyse the mode of transport and its impact on transport system and also the methods of assigning travel trips to various routes for effective management.</li> <li>Understand the mass transportation options and evaluation of the systems for economic sustainability.</li> </ul>			
<b>Module-1</b>			
<p><b>Urbanization Process:</b> Urban growth mechanism – Urban morphology - Urbanization &amp; travel demand Urban transport problems in India.  <b>Urban Transport Planning Process:</b> Urban travel patterns - Study area delineation- Zoning - Planning surveys - Urban activity system- Sustainable urban transport - Systems approach.</p>			
<b>Teaching- Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving		
<b>Module-2</b>			
<p><b>Travel Demand Estimate:</b> Trip based and activity-based approach - Four stage travel demand modeling - Data needs and outputs - Quick response techniques - Survey designs.  <b>Trip Generation:</b> Productions &amp; Attractions - Influential factors –Trip rate analysis-Category analysis- Simple &amp; Multiple linear regression models – FHWA method.</p>			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving.		
<b>Module-3</b>			
<p><b>Trip Distribution:</b> Interchange matrix – Growth factor methods – Synthetic methods calibration of Gravity model.  <b>Modal Split:</b> influential factors – FHWA Procedure – Diversion curves &amp; surfaces- Discrete choice models, Concept, Types, BL, MNL &amp; HL models.</p>			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving		
<b>Module-4</b>			
<p><b>Trip Assignment:</b> Trip Assignment procedure – Diversion curves- BPR model - All or Nothing assignment - Multipath assignment - Capacity restraint assignment – User equilibrium and system equilibrium approach - Stochastic assignment approach.</p>			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving		
<b>Module-5</b>			
<p><b>Land Use Transport System:</b> Urban system components - Urban spatial structure Accessibility - Location theory - Land use models - Land use transport models, Lowry &amp; Garin – Lowry models.  <b>Urban public transportation:</b> Urban growth and public transport needs - Transit mode classifications – Transit characteristics - Fleet size and capacity estimation  <b>Use of software's:</b> TransCAD, CUBE</p>			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, Skill enhancement through problem solving, software learning		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. Hutchinson, B.G., "Principles of Urban Transport System Planning"– McGraw Hill Book Co.
2. L.R. Kadiyali, "Traffic Engineering and Transportation Planning"– Khanna Publication.
3. Khisty C.J., Lall B.Kent, *Transportation Engineering – An Introduction*, Prentice-Hall, NJ, 2005
4. Ortuzar, J. D., Willumsen, L.G., *Modeling Transport*, John Wiley & Sons, 1994
5. Papacostas C.S. and Prevedourous, P.D., *Transportation Engineering & Planning*, PHI, New Delhi, 2002
6. Chakroborty P., Das N., *Principles of Transportation Engineering*, PHI, New Delhi, 2003
7. Dickey J.W., *Metropolitan Transportation Planning*, Tata Mc-Graw Hill 1980

**Reference Books:**

1. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning
2. Institute of Traffic Engineers – "An Introduction to highway Transportation Engineering", ITE, USA
3. Bowmen, J. and M. ben-Akiva, *Activity based travel Forecasting; in Activity based travel forecasting*. Washington, DC: U.S. Department of Transportation, Report DOT-97-17.  
Bruton M.J., *Introduction to Transportation Planning*, Hutchinson of London, 1988

**Web links and Video Lectures (e-Resources):**

- <https://archive.nptel.ac.in/courses/105/105/105105208/>
- <https://archive.nptel.ac.in/courses/105/107/105107067/>

**Skill Development Activities Suggested**

- Learning different modes of transportation from travel demand, trip generation, trip distribution and trip assignment – problem solving
- field studies to assess the travel patterns.
- Learning Transportation planning software such as **TransCAD, CUBE**

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Learn about several forms of transportation and the elements that influence the planning process for each mode.	L1, L2, L4, L5
CO2	Propose effective transport facility for the mass transportation after collecting the data required.	L1, L2, L3, L4, L5, L6
CO3	Calculate the distributions of trips as well as the inter-zonal trip generations or attractions.	L2, L3, L4, L5, L6
CO4	Analyse the influence of each form of transportation on the transportation system to better understand optimal route management.	L1, L2, L4, L6
CO5	Evaluate the economic sustainability of the mass transportation systems.	L1, L2, L6

**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X	X	X	X	X	-	X	X
CO2	X	X	-	-	X	X	-	X	X
CO3	X	X	X	X	X	X	-	X	X
CO4	X	X	-	-	X	X	-	X	X
CO5	X	X	X	X	X	X	-	-	X



## Semester- 3

<b>PAVEMENT MANAGEMENT SYSTEM (PEC)</b>			
Course Code	<b>MCHT313 /MCEM313</b>	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	3	Exam Hours	03
<p><b>Course Learning objectives:</b> This course will enable students to</p> <ul style="list-style-type: none"> <li>learn evaluation and prediction of pavement performance, to learn Ranking and economic optimization of pavement maintenance and rehabilitation and management.</li> </ul>			
<b>Module-1</b>			
<p><b>Introduction:</b> Components &amp; principals of pavement management systems, pavement maintenance measures, planning investment, research management. Pavement Management Data Needs, Inventory Data Needs, Project level and network level data needs Structural and functional requirements of flexible and rigid pavements. Pavement Distress survey and different types of failures in pavements.</p> <p><b>Evaluation of Pavement Surface distress condition surveys</b> – purpose, methods- manual and automated, types of distress, distress survey procedures, equipment used.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation.		
<b>Module-2</b>			
<p><b>Functional Evaluation of Pavements:</b> Importance of pavement evaluation, functional condition evaluation techniques, network, project level, roughness measurement methods, Identification of uniform sections, serviceability concepts, visual and rating procedures, data collection technologies, pavement deterioration, factors affecting pavement deterioration, modelling, and comparison of different deterioration models.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation, application of modern equipment's for field studies		
<b>Module-3</b>			
<p><b>Structural deterioration of pavements:</b> causes, effects, methods of treatment. Structural evaluation of flexible pavements by rebound deflection method, analysis of data, design of overlay, use of FWD and other methods for evaluation of flexible and rigid pavements and their application.</p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation, application of modern equipment's for field studies and laboratory studies		
<b>Module-4</b>			
Evaluation of new pavement materials, model studies, pavement testing under controlled conditions, accelerated testing and evaluation methods, Test track studies. Instrumentation for pavement testing.			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, data collection through field/site investigation, application of instrumentation for pavement testing through test track / Case studies		
<b>Module-5</b>			
<p><b>Rehabilitation:</b> Introduction, benefits of recycling, methods, recycling strategies, cold milling, ripping, crushing, recycling batch plant, drum mix plant, mix design, hot in place recycling techniques, cold in place recycling, full-depth reclamation, and current practices for improving riding quality. Ranking and optimization methodologies, life cycle costing</p> <p><b>Expert systems and Pavement Management:</b> Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge – based expert systems, case studies. Implementation of Pavement Management Systems.</p> <p><b>Use of software: HDM-4/dTIMS</b></p>			
<b>Teaching- Learning Process</b>	Black board, LCD, Skill enhancement through problem solving, Pavement asset management using modern software		

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**Suggested Learning Resources:****Text Books:**

1. Ralph Hass, W. Ronald Hudson with Lyne Cowe Falls., "Pavement Asset Management"-Scrivner Publisher, copyright 2015
2. Ralph Hass, W. Ronald Hudson. W. R., Zaniewisti J. "Modern Pavement Management" – Krieger Publishing Company, Florida, 1994.

**Reference Books:**

1. Proceedings of North American Conference on Managing Pavement.
2. Proceedings of International Conference on Structural Design of Asphalt Pavements.
3. NCHRP, TRR and TRB Special Reports.
4. Freddy L Roberts, Prithvi S Kandhal et al, "Hot Mix Asphalt Materials, mixture design and construction"- (2<sup>nd</sup> Edition), National Asphalt Pavement Association Research and Education Foundation, Maryland, USA.
5. Highway Hand Book by FAW, Publication from NUS, Singapore.
6. Nicholas J.Garber, Lester A. Hoel, "Traffic and Highway Engineering", Third Edition Thompson Learning
7. IRC 81, 1997, GUIDELINES FOR STRENGTHENING OF FLEXIBLE ROAD PAVEMENTS USING BENKELMAN BEAM DEFLECTION TECHNIQUE
8. IRC SP 16, 2004 Guidelines for Surface Evenness of Highway Pavements

**Web links and Video Lectures (e-Resources):**

- <https://youtu.be/hiAmA74ya-o>

**Skill Development Activities Suggested**

- Assessing pavement surface condition for a selected stretch of a road (Visual Road inventory survey)
- Demonstration on portable pendulum skid resistance tester for measuring skid resistance and data analysis
- Data Analysis from Structural and Functional evaluation
- Use of computer applications like HDM-4/dTIMS.

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

<b>Sl. No.</b>	<b>Description</b>	<b>Blooms Level</b>
CO1	Understand the structural and functional requirements of pavements, components of PMMS and pavement surface	L1, L2, L4
CO2	Functional condition evaluation, condition survey, pavement deterioration modelling	L5, L3, L4
CO3	Structural evaluation –BBD and FWD analysis	L5, L3, L4
CO4	Evaluation of new pavement materials, model studies,	L5, L3, L4
CO5	Recycling strategies, life cycle cost, Expert system and pavement management	L4, L5, L6


**Program Outcome of this course:** After successful completion of the program, the post graduates will be able to

Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

**Mapping of COS and POs**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	X	X				X	X	X
CO2	X	X	X		X	X	X	X	X
CO3	X	X	X	X		X		X	X
CO4	X	X		X	X				X
CO5	X	X	X	X	X	X	X		X

## Semester- 3

DATA ANALYTICS IN INFRASTRUCTURE ENGINEERING			
Course Code	MCHT314	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	26 Hours Theory + 26 Hours T/SDA	Total Marks	100
Credits	03	Exam Hours	03
<p><b>Course Learning objectives:</b> The objectives of the course are to:</p> <ul style="list-style-type: none"> <li>• Get an overall view of data analysis based on CRISP-DM process model.</li> <li>• Study data quality assessment and visualization techniques for data involving two attributes and for higher dimensional data.</li> <li>• Understand principles of modeling by going through various data modeling techniques.</li> <li>• Get a detailed account of data preparation phase.</li> <li>• Study statistical concepts related to data analysis.</li> <li>• Enable students to independently perform data analytic procedures on given data pertaining to civil engineering using Excel.</li> </ul>			
<b>Module-1</b>			
Data and knowledge, criteria to assess the knowledge, descriptive statistics of the data, inferential statistics, exploratory data analysis, knowledge discovery in data bases, data analysis processes, SEMMA, CRISP-DM, methods, tasks and tools.			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, web resources		
<b>Module-2</b>			
Attribute understanding, kinds of attributes (nominal, interval, ratio types). Characteristics of one dimensional data, location measures, dispersion measures, and shape measures. Characteristic measures of multidimensional data, data quality, visual analytics of one-dimensional data, density plots, box plots, scatter plots. Correlation and covariance. Methods for multidimensional data (just briefing). Analysis of data pertaining to civil engineering infrastructure/ highway technology.			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, web resources		
<b>Module-3</b>			
The four steps of modeling, model classes, black-box models, fitting criteria and score functions, error functions for classification problems, measure of interestingness, closed form algorithm for model fitting. Types of errors. Model validation (briefing on methods). Modeling on the data specific to civil engineering infrastructure/ highway technology.			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, web resources		
<b>Module-4</b>			
Selection of data, feature selection, selecting top ranked subset of data, cross product, wrapper approach, and correlation-based filter. Cleaning data, improving data quality, dealing with missing values, construct data, providing operability, assuring impartiality and maximize efficiency. Complex data types. Implementation of methods on data specific to civil engineering infrastructure/ highway technology.			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, web resources		
<b>Module-5</b>			
Clustering – methods. Hierarchical clustering. Dissimilarity measures; Minkowisci, Euclidian, Manhattan, Chebyshev, and cosine. Deviation measures. Association rules. Brief introduction to self-organizing maps. Implementation of methods on data specific to branch of specialization.			
<b>Teaching-Learning Process</b>	Black board, PowerPoint Presentations, web resources		
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.</p> <p><b>Continuous Internal Evaluation:</b></p> <ul style="list-style-type: none"> <li>• Two Unit Tests each of 25 Marks</li> <li>• Two assignments each of 25 Marks or one Skill Development Activity of 50 marks</li> </ul> <p>to attain the COs and POs</p>			

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**.  
**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module

**1.**

1.		
<b>Suggested Learning Resources:</b>		
<b>Text Book:</b>		
1. Michel R. Berthold, Christian Borgelt, Frank Hoopner, Guide to Intelligent Data Analysis, Springer- Verlag Publications, ISBN 978-1-84882-259-7, DOI 10.1007/978-1-84882-260-3, London, 2010		
<b>Reference:</b>		
1. Charles M.Zudd, Garry H.Mcchelland, Carry S.Ryan, Data Analysis: A Model Comparison Approach, Routledge Publication, NY, 2009.		
2. Allan Agresti, An Introduction to Categorical Data Analysis, 2 <sup>nd</sup> Edition, Wiley Publication		
<b>Web links and Video Lectures (e-Resources):</b>		
<ul style="list-style-type: none"> <li>• <a href="http://www.kdnuggets.com">www.kdnuggets.com</a></li> <li>• <a href="http://www.kaggle.com">www.kaggle.com</a></li> <li>• <a href="http://www.datameer.com">www.datameer.com</a></li> </ul>		
<b>Skill Development Activities Suggested</b>		
<ul style="list-style-type: none"> <li>• Students in groups (not more than two) need to take up data pertaining to civil engineering/ Infrastructure Engineering/ Highway Technology and apply all the methods learnt during the course, implement the methods using Excel /R and prepare a small report.</li> </ul>		
<b>Course outcome (Course Skill Set)</b>		
At the end of the course the student will be able to:		
Sl. No.	Description	Blooms Level
CO1	Demonstrate a sophisticated understanding of the concepts and methods, know the exact scopes and possible limitations of each method and tasks involved. Apply CRISP-DM data analysis processes to civil engineering related data in decision making.	L2
CO2	Apply appropriate data visualization techniques and perform correlation analysis on the real-world data pertaining to allied areas of civil engineering / infrastructure / Highway technology	L3
CO3	Develop appropriate model for the data using the suitable algorithm and validate the so developed model using appropriate validation technique.	L4
CO4	Decide on appropriate method/ technique for data preparation and provide operability by assuring impartiality and integrity to the given real-world data drawn from various sub domains of civil engineering/ infrastructure/Highway technology	L5
CO5	Perform similarity analysis using similarity metrics and to implement simple clustering techniques of the given data set in one and multiple dimensions.	L6

Program Outcome of this course		
Sl. No.	Description	POs
1	Independently carryout research / investigation and development work to solve practical problems related to highway technology.	PO1
2	Write and present a substantial technical report /document in the field of Highway technology.	PO2
3	Demonstrate a degree of mastery over materials, analysis, design, construction, maintenance and management of highways considering societal and environmental considerations.	PO3
4	Use modern tool for design, analysis and management of highways.	PO4
5	Adopt safe, economical, ethical and sustainable factors in design, construction and management of highways.	PO5
6	possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.	PO6
7	The Graduates will demonstrate knowledge and understanding of the critical issues for professional practices such as the procurement of works, interaction with contractors during the construction phase of a project, the finance management and managerial capabilities.	PO7
8	Function effectively in multi-disciplinary projects and demonstrate team building and leadership qualities.	PO8
9	The student engages in lifelong learning for professional advancement.	PO9

  

Mapping of COS and POs								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1						X		
CO2						X		
CO3						X		
CO4						X		
CO5						X		



Semester- 3

<b>INDUSTRIAL INTERNSHIP</b>			
Course Code	MINT384	CIE Marks	50
Number of contact Hours	06 Weeks	SEE Marks	50
Credits	06	Exam Hours	03
<p><b>Course objectives:</b>            Internship provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective is further,</p> <ul style="list-style-type: none"> <li>• To put theory into practice.</li> <li>• To expand thinking and broaden the knowledge and skills acquired through course work in the field.</li> <li>• To relate to, interact with, and learn from current professionals in the field.</li> <li>• To gain a greater understanding of the duties and responsibilities of a professional.</li> <li>• To understand and adhere to professional standards in the field.</li> <li>• To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.</li> <li>• To identify personal strengths and weaknesses.</li> <li>• To develop the initiative and motivation to be a self-starter and work independently.</li> </ul>			

**Internship/Professional practice:** Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

**Seminar:** Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Course outcomes:**

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

## Semester III

## PROJECT WORK PHASE – 1

Course Code	22PRJ481	CIE Marks	100
Number of contact Hours/Week (L:P:S)	00:06:00	SEE Marks	--
Credits	20	Exam Hours	--
<b>Course objectives:</b> <ul style="list-style-type: none"> <li>• Support independent learning.</li> <li>• Guide to select and utilize adequate information from varied resources maintaining ethics.</li> <li>• Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.</li> <li>• Develop interactive, communication, organisation, time management, and presentation skills.</li> <li>• Impart flexibility and adaptability.</li> <li>• Inspire independent and team working.</li> <li>• Expand intellectual capacity, credibility, judgement, intuition.</li> <li>• Adhere to punctuality, setting and meeting deadlines.</li> <li>• Instil responsibilities to oneself and others.</li> <li>• Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.</li> </ul>			

**Project Phase-1** Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

**Seminar:** Each student, under the guidance of a faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Course outcomes:**

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilizing a systems approach.
- Communicate with engineers and the community at large in written an oral form.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

## Semester IV

## PROJECT WORK PHASE -2

Course Code	MPRJ481	CIE Marks	100
Number of contact Hours/Week (L:P:S)	00:08:00	SEE Marks	100
Credits	22	Exam Hours	03
<b>Course objectives:</b> <ul style="list-style-type: none"> <li>• To support independent learning.</li> <li>• To guide to select and utilize adequate information from varied resources maintaining ethics.</li> <li>• To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.</li> <li>• To develop interactive, communication, organization, time management, and presentation skills.</li> <li>• To impart flexibility and adaptability.</li> <li>• To inspire independent and team working.</li> <li>• To expand intellectual capacity, credibility, judgement, intuition.</li> <li>• To adhere to punctuality, setting and meeting deadlines.</li> <li>• To instill responsibilities to oneself and others.</li> <li>• To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.</li> </ul>			
<b>Project Work Phase - II:</b> Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.			

**Course outcomes:**

At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

