

Rashtreeya Sikshana Samithi Trust

R.V. College of Engineering

(Autonomous Institution Affiliated to VTU, Belagavi)



Department of Civil Engineering

Master of Technology (M. Tech.)

HIGHWAY TECHNOLOGY

**Scheme and Syllabus of
Autonomous System w.e.f 2016**

R.V. College of Engineering, Bengaluru – 59*(Autonomous Institution Affiliated to VTU, Belagavi)***M. Tech. Highway Technology
Department of Civil Engineering**

Vision: Excel in Education, Research and Consultancy in Civil Engineering with emphasis on sustainable Development

Mission:

1. Disseminating and integrating the knowledge of structural, transportation, environmental and geotechnical engineering
2. Enhancing Industry – Institute interaction leading to Interdisciplinary research
3. Imbibing wide range of skills in cutting edge technology for sustainable development
4. Motivate entrepreneurship and professional ethics to serve the society

Program: HIGHWAY TECHNOLOGY**Program Educational Objectives (PEO)**

M. Tech. in Highway Technology Program, graduates will be able to:

PEO1: Analyze, design, construct, evaluate and maintain bituminous, concrete and composite pavements.

PEO2: Exhibit professionalism in consultancy, entrepreneurship and academics in highway technology.

PEO3: Engage in lifelong learning through research including association with professional societies.

PEO4: Adopt sustainable and inclusive technologies to address societal needs.

Program Outcomes (PO)

M. Tech. in Highway Technology graduates will be able to:

PO1: Scholarship of Knowledge – Acquire in depth knowledge of highway technology, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge and integration of same for enhancement of Knowledge

PO 2: Critical Thinking – Analyze complex highway engineering problems critically, apply independent judgement for synthesizing information to make intellectual and or creative advances for conducting research in theoretical, practical and policy context.

PO3: Problem Solving – Think laterally and originally, conceptualize and solve highway technological problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors.

PO4: Research Skill – Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually / in groups to the development of scientific / technological knowledge in one or more domains of materials, design, construction, maintenance and management of pavements.

PO5: Usage of Modern tool – Create, select, learn and apply appropriate techniques, resources and modern engineering and software for prediction and modeling of pavement performances.

PO6: Collaborative and multidisciplinary research – Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative multi-disciplinary scientific research, demonstrate capacity for self-management and team work, decision making based on open mindedness, objectivity and rational analysis in order to achieve common goals and further learning of themselves as well as others

PO7: Project management and Finance- Demonstrate knowledge and understanding of highways and project management and apply the same to one's own work as a member and leader in team, manage projects efficiently in highway technology and inter-disciplinary environments after consideration of economic and financial factors

PO8: Communication – Communicate with the engineering community and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations and give and receive clear instructions.

PO9: Life Long Learning – Recognize the need for, and have the preparation and ability engage in lifelong learning independently, with high level of enthusiasm and commitment to improve knowledge and competence continuously

PO10: Ethical Practices and Social responsibility – Acquire and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society

PO11 Independent and reflective thinking – Observe and examine critically outcome of ones actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

Program Specific Criteria (PSC)

Lead Society: American Society of Civil Engineers

1. Curriculum

The program prepares students for professional, teaching and research careers. Emphasis is on the acquisition of knowledge concerning planning, design, construction, maintenance, management and evaluation of highway facilities with due consideration to public governing policies and guidelines.

2. Faculty competency

Faculties are qualified with post graduate and doctoral degrees in the stream of highway and transportation engineering. The faculties are actively publishing research papers in reputed national and international journals related to highway and transportation engineering. The faculty are also actively involved in industrial consultancy and associated with professional bodies.

Program Specific Outcomes (PSO)

M. Tech. in Highway Technology graduates will be able to:

- PSO 1.** Apply knowledge of materials, analysis and design for construction, maintenance and management of pavements.
- PSO 2.** Demonstrate the ability to carry out pavement surveys and investigations for road projects.

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FIRST SEMESTER								
Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture	Tutorial	Practical	Experiential Learning	
				L	T	P	S	
1	16MEM11P	Project Management	IEM	3	1	0	0	4
2	16MHT12	Highway Materials	CV	4	0	1	0	5
3	16MHT13	Pavement Analysis and Design	CV	4	0	0	1	5
4	16MHT14	Traffic Engineering	CV	4	0	0	0	4
5	16MHT15X	Elective -1	CV	4	0	0	0	4
6	16HSS16	Professional Skill Development	HSS	0	0	2	0	2
		Total		19	1	3	1	24

Elective 1	
16MHT151	Applied Geotechnology for Highway Engineers
16MHT152	Highway Geometric Design

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SECOND SEMESTER								
Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture L	Tutorial T	Practical P	Experiential Learning S	
1	16MEM21R	Research Methodology	IEM	3	1	0	0	4
2	16MHT22	Highway Construction and Maintenance	CV	4	0	1	0	5
3	16MHT23X	Elective -2	CV	4	0	0	0	4
4	16MHT24X	Elective -3	CV	4	0	0	0	4
5	16MHT25X	Elective -4	CV	4	0	0	0	4
6	16MHT26	Minor Project (in-house)	CV	0	0	5	0	5
Total				19	1	6	0	26

Elective 2		Elective 3		Elective 4	
16MHT231	Highway Economics	16MHT241	Road Projects	16MHT251	Road Construction Planning and Management
16MHT232	Urban Public Transport	16MHT242	Road Safety Engineering	16MHT252	Road Construction Equipment

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THIRD SEMESTER								
Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture L	Tutorial T	Practical P	Experiential Learning S	
1	16MHT31	Pavement Deterioration and Evaluation (Theory & Practice)	CV	4	0	1	0	5
2	16MHT32X	Elective -5	CV	4	0	0	0	4
3	16MHT33X	Elective -6	CV	4	0	0	0	4
4	16 MST 34X /16MHT34X	Elective -7	CV	4	0	0	0	4
5	16MHT35	Internship/ Industrial Training	CV	0	0	3	0	3
6	16MHT36	Technical Seminar	CV	0	0	2	0	2
		Total		16	0	6	0	22

Elective 5		Elective 6		Elective 7	
16MHT321	Pavement Management System	16MHT331	Special Problems in Road Construction	16MHT341/ 16MST341	Design of Bridges, flyovers and grade separators
16MHT322	Intelligent Transport System	16MHT332	Transportation Planning	16MHT342/ 16MST342	Earth Retaining structures

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FOURTH SEMESTER								
Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture	Tutorial	Practical	Experiential Learning	
				L	T	P	S	
1	16MHT41	Major Project	CV	0	0	26	0	26
2	16MHT42	Seminar	CV	0	0	2	0	2
		Total		0	0	28	0	28

I SEMESTER

PROJECT MANAGEMENT						
Course Code	:	16MEM11P		CIE Marks	:	100
Hrs/Week	:	L: T: P: S	3:2:0:0	SEE Marks	:	100
Credits	:	4		SEE Duration	:	3 Hrs
Course Learning Objectives:						
Students are able to						
1. Understand the principles and components of project management.						
2. Appreciate the integrated approach to managing projects.						
3. Elaborate the processes of managing project cost and project procurements.						
4. Apply the project management tools and techniques.						
Unit – I						7 Hours
Introduction: Project, Project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge.						
Unit – II						8 Hours
Generation and Screening of Project Ideas: Generation of ideas, monitoring the environment, corporate appraisal, scouting for project ideas, preliminary screening, project rating index, sources of positive net present value. Project costing,						
Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope.						
Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle.						
Unit – III						7 Hours
Project Integration Management: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.						
Project Quality management: Plan quality management, perform quality assurance, control quality.						
Unit – IV						7 Hours
Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk.						
Project Cost Management: Plan cost management, estimate cost, determine budget, cost control						
Unit-V						7 Hours
Network Techniques for Project Management: Development of project network, time estimation, determination of the critical path, PERT Model, CPM model, numerical problems. Scheduling when resources are limited.						
Syllabus includes tutorials for two hour per week:						
<ul style="list-style-type: none"> • Case discussions on project management • Numerical problems on PERT & CPM • Computerized project management exercises using M S Project Software 						

Course Outcomes:

After going through this course the student will be able to

CO1: Explain the process of project management and its application in delivering successful projects.

CO2: Illustrate project management process groups for various project / functional applications.

CO3: Appraise various knowledge areas in the project management framework.

CO4: Develop project plans and apply techniques to monitor, review and evaluate progress for different types of projects.

Reference Books:

1. Project Management Institute, “A Guide to the Project Management Body of Knowledge (PMBOK Guide)”, 5th Edition, 2013, ISBN: 978-1-935589-67-9
2. Harold Kerzner, “Project Management A System approach to Planning Scheduling & Controlling”, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
3. Prasanna Chandra, “Project Planning Analysis Selection Financing Implementation & Review”, Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.
4. Rory Burke, “Project Management – Planning and Controlling Techniques”, John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	----	M	H	H	H	----	H	----
CO2	----	M	----	-----	M	H	H	H	L	H	----
CO3	---	M	H	---	M	H	H	H	H	H	M
CO4	M	H	M	L	H	H	H	H	----	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	L
CO2	L	-
CO3	L	L
CO4	L	-

HIGHWAY MATERIALS (Theory & Practice)						
Course Code	:	16MHT12		CIE Marks	:	100+50
Hrs/Week	:	L:T:P:S	4:0:1:0	SEE Marks	:	100+50
Credits	:	05		SEE Duration	:	3 Hrs+3Hrs
Course Learning Objectives (CLO):						
Student will be able to						
<ol style="list-style-type: none"> 1. Understand the specifications requirements and properties of materials used for road construction. 2. Analyze the properties and requirements of different types of mixes used for road construction. 3. Evaluate different materials and mixes for pavements. 4. Propose suitable materials and mixes for pavements. 						
Unit – I						09Hrs
Soil – types, source, functions, requirements, properties, tests and specifications for use in various components of road. Soil compaction- factors and methods, Alternate and new materials-characteristics and application in highways						
Unit – II						10Hrs
Aggregates –Natural and Manufactured Aggregates, Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation, shape factors						
Unit – III						09Hrs
Bituminous binders – different types, properties and uses, physical tests on bitumen, Rheological and pavement performance related properties, Modified binders, requirements of ideal pavement binders, characteristics and applications in road construction, criteria for selection of different binders. Bituminous mixes, types, requirements, properties, tests, Marshall Method of mix design, Criteria and super pave mix design, Additives & Modifiers in Bituminous mixes, problems on mix design.						
Unit – IV						10Hrs
Portland cement and cement concrete for use in road works – requirements, design of mix for CC pavement, use of additives, IRC specifications & Tests, joint filler and sealer materials.						
Unit – V						10Hrs
Soil stabilization – principle, methods and tests, proportioning of materials and mix design, Marginal/waste/ alternative materials in road construction, their properties and scope in road construction. Use of Fly-ash in road embankment and cement concrete mixes, use of chemical stabilizers in road construction.						
Unit – VI (Lab Component)						
<ol style="list-style-type: none"> 1. Tests on materials <ol style="list-style-type: none"> i. Penetration on aged binders ii. Viscosity using rotational viscometer iii. Elastic recovery iv. Separation test 2. Tests on mixes <ol style="list-style-type: none"> v. Bitumen extraction and gradation vi. Mix design by Marshall Method for dense bituminous mixes. 						

- vii. Temperature susceptibility and Moisture susceptibility using indirect tensile strength test for bituminous mixes
- viii. Indirect tensile repeated load tests

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Explain properties and requirements of materials and mixes used for pavements

CO2: Analyze properties of different materials and mixes used for pavements

CO3: Evaluate suitability of different materials and mixes for pavements.

CO4: Propose suitable materials and mixes for pavements.

Reference Books:

1. 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, ISBN-10: 0914313010
2. “Soil Mechanics for Road Engineers”- Her Majesty's Stationary Office, 1952 Publication, ISBN 10: 0115502785 ISBN 13: 9780115502781
3. “Bituminous materials in Road Construction”- Her Majesty's Stationary Office, 1962 Publication, ISBN 10: 0115502785 ISBN 13: 9780115502781
4. Highway Hand Book of highway Engineering, T F Fwa, CRC Press, September 28, 2005, ISBN 9780849319860
5. MoRTH – V Revision, ‘Specifications for Roads and Bridges Works’- Indian Roads Congress, April 2013

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H							L	L		
CO2		M						L			
CO3								L	L		
CO4			M							L	

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	L	L
CO3	L	-
CO4	M	-

PAVEMENT ANALYSIS AND DESIGN						
Course Code	:	16MHT13		CIE Marks	:	100
Hrs/Week	:	L:T:P:S	4:0:0:1	SEE Marks	:	100
Credits	:	05		SEE Duration	:	03 Hrs
Course Learning Objectives (CLO):						
Student will be able to						
<ol style="list-style-type: none"> 1. Discuss the factors influencing design of pavements 2. Analyze the stresses and strains in pavements 3. Understand AASHTO, Asphalt institute and shell method of design 4. Design flexible and rigid pavements as per IRC guidelines 						
Unit – I						10Hrs
Pavements - types, functions, choice Factors affecting design and performance of flexible and rigid pavements – Pavement design factors, loads – axle load distribution, ESWL, EWL, VDF.						
Unit – II						10Hrs
Subgrade support - CBR and plate bearing tests, Resilient Modulus, fatigue tests, permanent deformation Pavement material Characteristics, climatic, drainage and environmental factors, their effects and evaluation. Factors affecting design and performance of airport pavements.						
Unit – III						10Hrs
Stresses and Deflection / strain in flexible pavements: Application of elastic theory, stresses, deflections / strains in single, two and three layer system, Applications in pavement design. Visco elastic theory						
Unit – IV						10Hrs
Flexible pavement design: Empirical, semi- empirical and theoretical design approaches, principle, advantages and application. Design steps by CBR method as per IRC 2001 and 2012 , outline of other common design methods such as AASHTO and Asphalt Institute and Shell methods.						
Unit – V						10Hrs
Rigid pavement design: Determination of ESWL, EWL for dual and dual tandem wheel loads in Rigid pavements, General design principle, Stresses in rigid pavements, stresses due to wheel loads and temperature variations, design of cement concrete pavements (joints and slab thickness) as per IRC -58-2015 guidelines.						
Introduction to Design Software : KENSLAB, KENLAYER						
Expected Course Outcomes:						
After successful completion of this course the student will be able to:						
<ol style="list-style-type: none"> 1. Explain parameters and methods of pavement design. 2. Analyze the parameters for pavement design 3. Select suitable parameters for design of pavements. 4. Design flexible and rigid pavements. 						
Reference Books:						

1.	Yoder and Witczak, “Principles of Pavement Design”- John Wiley and sons Inc (second edition) 1975, ISBN : 978-81-265-3072-4
2.	Huang, “Pavement Analysis and Design”- Pearson Publications, 2004, ISBN-13:9780131424739.
3.	David Croney, Paul Croney, “Design & Performance of Road Pavements”- Mc Graw hill Book Co. (Third Edition), 1997, ISBN-13:9780070144514.
4.	IRC 37-2001, 2012, IRC 81-1997, IRC 58 – 2002, 2015. IRC 59 – 1976, IRC 101-1988,

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H		H					L	L		
CO2		M			M			L			
CO3			M								L
CO4	H	M	M						L	H	

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	L
CO2	M	-
CO3	L	-
CO4	H	-

TRAFFIC ENGINEERING					
Course Code	:	16MHT14		CIE Marks	: 100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	: 100
Credits	:	04		SEE Duration	: 03 Hrs
Course Learning Objectives (CLO):					
Student will be able to					
<ol style="list-style-type: none"> 1. Understand traffic, traffic flow characteristics, regulations and management of traffic. 2. Identify traffic characteristics for design and management. 3. Analyze the traffic parameters 4. Evaluate traffic and design the signals. 					
Unit – I					10Hrs
Traffic and road user characteristics – human factors including reaction time and vehicular characteristics affecting road design and traffic flow, motor vehicle act					
Traffic studies - data collection, analysis and interpretation of results of classified traffic volume, spot speed, speed and delay, origin and destination. Sampling in traffic studies – sampling techniques, sampling theory, accuracy and sample size. Accident characteristics, causes, studies, investigations and analysis of individual accidents, statistical analysis, measures to improve road safety. Problems on above.					
Unit – II					10Hrs
Traffic flow characteristics, traffic flow variables, and speed – flow – density relationship, PCU values, level of service, factors influencing roadway capacity, capacity of roads at various levels of service, capacity of intersections.					
Introduction to Queuing theory: vehicle arrivals, delays at intersections, -Problem.					
Unit – III					10Hrs
Traffic regulations and control - Regulation on vehicles, drivers and traffic flow, Parking studies, Traffic control devices – Types & objectives of markings, signs, signals and islands, delineators.					
Unit – IV					10Hrs
Design of signalized intersections including signal timings as per IRC guidelines. Signal system, use of software. Problems. Design of other types of intersections at grade such as intersections with markings, channelized intersections and traffic rotary. Traffic design of grade separated intersections and interchange facilities.					
Unit – V					08Hrs
Traffic management techniques - Local area management. Low cost measures. Various types of medium and long term traffic management measures and their uses.					
Environmental issues – air and noise pollution due to road traffic, measurement, control of environmental deterioration. Management of environmental pollution due to road traffic.					
Expected Course Outcomes:					
After successful completion of this course the student will be able to:					
CO1: Explain traffic, traffic flow characteristics, regulations and management of traffic.					
CO2: Analyze traffic, traffic flow characteristics, regulations and management of traffic					
CO3: Evaluate traffic characteristics for design and management.					

CO4: Design and recommend solutions for traffic problems.

Reference Books:

1. Kadiyali L.R. “Traffic Engineering and Transportation Planning”-Khanna Publication, New Delhi.2011, ISBN-13:9788174092205.
2. Matson T M, Smith W S , Hurd F W, “ Traffic Engineering, Mc graw Hill Book Co, NY , USA, ISBN 0131424718
3. Drew D R ,” Traffic Flow Theory and Control”, McGraw Hill Book Co, NY, USA. ISBN-13: 978-0070178311.
4. N J Garber & L A Hoel, “Traffic and Highway Engineering”, (Fifth Edition), 2015, ISBN-13:9781133605157.
5. IRC3-1983,9-1972,62-1976,64-1990,65-1976,66-1976,67-2001,69-1977,70-1977,73-1980,79-1981,80-1981,86-1983,92-1985,93-1985,99-1988,102-1988,103-1988,106-1990,110-1996 Indian Roads Congress.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H							L	L		
CO2		M	H					L	L		
CO3	H							L	L		
CO4	M		M								

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	-
CO2	L	H
CO3	L	M
CO4	-	L

APPLIED GEOTECHNOLOGY FOR HIGHWAY ENGINEERS						
Course Code	:	16MHT151		CIE Marks	:	100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	:	100
Credits	:	04		SEE Duration	:	03 Hrs
Course Learning Objectives (CLO):						
Student will be able to						
1. Understand the strength and behavior of soil as a highway material.						
2. Apply the properties of soils for design of embankments/cuts and pavements.						
3. Analyze the strength, stability of soil for embankments/cuts and pavements.						
4. Evaluate and design the slopes, drainage and retaining structures.						
Unit – I						10Hrs
Introduction: Soil Mechanics applications to Highway Engineering. Index properties, , various soil classification systems, HRB classification, Soil Compaction; Method of Compaction- Laboratory and Field						
Unit – II						10Hrs
Shear strength of soil: Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson’s ratio, Shear Modulus.						
Stability of slopes: Introduction, Types, Different methods of analysis of slopes for $\phi_u=0$ & $C-\phi$ soil, Location of most critical circle, Earth dam slopes stability, Taylor’s stability number. Effect of Earthquake Force,						
Unit – III						10Hrs
Permeability of soil: Darcy’s Law, Validity, Soil-water system, Types, Determination of permeability, problems.						
Site Investigation: Planning and exploration Methods of Sampling, SPT, Subsoil investigation, Geophysical methods.						
Unit – IV						10Hrs
Highway Drainage: Importance, Surface drainage, Sub-surface drainage, Design of Surface and subsurface drainage system, Road construction in water logged and coastal areas, Landslides – Types, factors and remedial measures.						
Unit – V						10Hrs
Reinforced Earth structures Definition, Components, Advantages, Types of stability – external, Internal, (No problems), Geo textiles – types, Functions, their uses in road embankments and railway works, other uses.						
Expected Course Outcomes:						
After successful completion of this course the student will be able to:						
CO1: Explain the properties of soil as a highway material.						
CO2: Analyze soils for their application in pavements, embankment/cuts.						
CO3: Examine the suitability of soil for embankments/cuts and subgrade.						
CO4: Design geotechnical solutions for embankments/cuts and subgrade.						
Reference Books:						
1.	“Basic and Applied soil Mechanics”, Gopal Ranjan, ASR Rao, New Age International Publishers. ISBN: 9788122412239, 8122412238					

2.	“Soil Mechanics & Foundation Engg”, Dr.B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd, 16 th edition Academic press, 2012 ISBN: 978-0-12-381375-6.
3.	“Highway Engg”, S.K. Khanna, C.E.G. Justo, and Veeraragavan A 10 th edition. Nem Chand Bros Rookee ISBN 978-81-85240-72-5
4.	“Soil Mechanics for road Engineers” – HMSO, London. ISBN 10: 0115502785

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M							L	L		
CO2		H						L	L		
CO3	M	M									
CO4	M		H								

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	M	-
CO3	M	M
CO4	M	-

HIGHWAY GEOMETRIC DESIGN					
Course Code	:	16MHT152		CIE Marks	: 100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	: 100
Credits	:	04		SEE Duration	: 03 Hrs
Course Learning Objectives (CLO):					
Student will be able to					
<ol style="list-style-type: none"> 1. Identify the geometrical design elements. 2. Apply the geometric elements for varying conditions of roads. 3. Analyze the geometric elements for highway geometric design. 4. Design and evaluate the geometric element facilities for varying highway conditions. 					
Unit – I					10Hrs
Introduction: Geometric design provisions for various transportation facilities as per IRC guidelines, Factors governing geometric design, geometric design elements, route selection, geometric design consistency					
Unit – II					10Hrs
Geometric Design Elements: Sight distances-Types, analysis, Factors affecting, measurements, horizontal alignment-Design consideration. Stability at curves, Super elevation, widening, transition curves, curvature at intersection, vertical alignment-Grades, ramps, design of summit and valley curves, Combination of vertical and horizontal alignment including design of hair pin bends					
Unit – III					10Hrs
Cross Section Elements: Right of way and width consideration, roadway, shoulders, kerbs, traffic barriers, medians, frontage roads, Facilities for pedestrians, bicycles, buses and trucks ,pavement surface characteristics-Types, cross slope ,skid resistance, unevenness.					
Design Considerations: Design considerations for rural and urban roads - Design speeds, volumes, level of service and other design consideration.					
Unit – IV					09Hrs
Intersection Design : At grade intersections – sight distance consideration and principles of design, Channelization, mini round – about, layout of round – about, Inter – Changes – major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes, Bicycle and pedestrian facility design, Parking layout and design, Terminal layout and design.					
Unit – V					09Hrs
Requirements of Expressways: Geometric Design and General Features, Grade Separators and Interchanges, Embankment and Cut Sections, Pavement Design, Tunnels Drainage, Traffic Control Devices, Road Safety Devices and Road Side Furniture, Traffic Management Systems, Toll Plazas, Project Facilities: Service Areas, Pick-Up Bus Stops, State Border Check Posts, Environmental and Social Aspects, Landscaping and Tree Plantation, Lighting.					

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Explain the geometrical design elements.

CO2: Plan the geometric elements for varying conditions of roads.

CO3: Examine the geometric elements for highway geometric design.

CO4: Judge and propose suitable geometry.

Reference Books:

1. Khanna S.K, Justo CEG, Veeraragavan A “Highway Engineering” Khanna Publishers, 10th Edition, 2015,ISBN: 9788185240800.
2. A Policy on Geometric Design of Highways and Streets, (The Green Book) 6th Edition, American Association of State Highway and Transportation Officials (AASHTO) Publishers, 2011,ISBN Number: 978-1-56051-508-1.
3. John G Schoon “Geometric design projects for Highways: An Introduction” 2nd Edition, American Society of Civil Engineers Press, ISBN: 978-0-7844-7042-8, 2000.
4. Donald R. Drew “Traffic Flow Theory and Control” McGraw-Hill Inc.,US (1 June 1968), ISBN-10: 0070178313.
5. Relevant Indian Roads Congress Code Books(IRC)
IRC011-1962,IRC012-2009,IRC032-1969,IRC064-1990,IRC066-1976,IRC073-1990,IRC080-1981,IRC086-1983,ITC092-1985,IRCSP023-1993.,IRCSP99 2013.Publisher Indian Roads Congress, New Delhi.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H							L	L	L	
CO2		H						L	L	L	
CO3	M		H								
CO4	H	M								L	

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	-
CO2	H	L
CO3	H	-
CO4	M	-

PROFESSIONAL SKILL DEVELOPMENT						
Course Code	:	16HSS16		CIE Marks	:	50
Hrs/Week	:	L:T:P:S	0:0:4:0	Credits	:	02
Course Learning Objectives:						
Students are able to						
<ol style="list-style-type: none"> 1. Understand the importance of verbal and written communication 2. Improve qualitative and quantitative problem solving skills 3. Apply critical and logical think process to specific problems 4. Manage stress by applying stress management skills 						
UNIT 1						5 Hours
Communication Skills: Basics of Communication, Personal Skills & Presentation Skills, Attitudinal Development, Self Confidence, SWOC analysis.						
Resume Writing: Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts.						
UNIT 2						6 Hours
Quantitative Aptitude and Data Analysis: Number Systems, Math Vocabulary, fraction decimals, digit places etc. Reasoning and Logical Aptitude, - Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. Verbal Analogies – introduction to different question types – analogies, sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. Reading Comprehension, Problem Solving						
UNIT 3						4 Hours
Interview Skills: Questions asked & how to handle them, Body language in interview, Etiquette, Dress code in interview, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, General HR interviews						
UNIT 4						5 Hours
Interpersonal and Managerial Skills: Optimal co-existence, cultural sensitivity, gender sensitivity; capability and maturity model, decision making ability and analysis for brain storming; Group discussion and presentation skills;						
UNIT 5						4 Hours
Motivation and Stress Management: Self motivation, group motivation, leadership abilities Stress clauses and stress busters to handle stress and de-stress; professional ethics, values to be practiced, standards and codes to be adopted as professional engineers in the society for various projects.						
Note: The respective departments should discuss case studies and standards pertaining to their domain						
Course Outcome:						
After going through this course the students will be able to						
CO1: Develop professional skill to suit the industry requirement						
CO2: Analyze problems using quantitative and reasoning skills						
CO3: Develop leadership and interpersonal working skills						
CO4: Demonstrate verbal communication skills with appropriate body language.						

References

1. Stephen R Covey, “The 7 Habits of Highly Effective People”, Free Press, 2004 Edition, ISBN: 0743272455
2. Dale Carnegie, “How to win friends and influence people”, General Press, 1st Edition, 2016, ISBN: 9789380914787
3. Kerry Patterson, Joseph Grenny, Ron Mcmillan, “Crucial Conversation: Tools for Talking When Stakes are High”, McGraw-Hill Publication, 2012 Edition, ISBN: 9780071772204
4. Ethnus, “Aptimithra: Best Aptitude Book”, Tata McGraw Hill, 2014 Edition, ISBN: 9781259058738

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in TWO Phases

Phase	Activity	Weightage
I	After 7 weeks - Unit 1, 2 & Part of Unit 3	50%
II	After 12 weeks – Unit 3, 4, 5	50%

CIE Evaluation shall be done with weightage as follows:

Writing skills	10%
Logical Thinking	25%
Verbal Communication & Body Language	35%
Leadership and Interpersonal Skills	30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	---	L	---	---	H	---	H	H	H	M
CO2	H	M	H	---	---	---	---	---	M	H	M
CO3	---	---	L	---	---	H	---	H	H	H	H
CO4	---	---	H	---	---	H	L	H	H	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	L
CO2	-	M
CO3	-	M
CO4	-	M

II SEMESTER

RESEARCH METHODOLOGY						
Course Code	:	16MEM21R		CIE Marks	:	100
Hrs/Week	:	L: T: P: S	3:2:0:0	SEE Marks	:	100
Credits	:	04		SEE Duration	:	3 Hours
Course Learning Objectives:						
Students are able to						
1. Understand of the underlying principles of quantitative and qualitative research						
2. Perform the gap analysis and identify the overall process of designing a research study.						
3. Choose the most appropriate research methodology to address a particular research problem						
4. Explain a range of quantitative and qualitative approaches to analyze data and suggest possible solutions.						
Unit – I						7 Hours
Overview of Research						
Meaning of Research, Types of Research, Research and Scientific Method, Defining the Research Problem, Research Design, Different Research Designs.						
Unit – II						7 Hours
Methods of Data Collection						
Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.						
Unit – III						8 Hours
Sampling Methods						
Sampling process, Non-probability sampling, probability sampling: simple random sampling, stratified sampling, cluster sampling systematic random sampling, Determination of sample size, simple numerical problems.						
Unit – IV						7 Hours
Processing and analysis of Data						
Processing Operations, Types of Analysis, Statistics in Research, Measures of: Central Tendency, Dispersion, Asymmetry and Relationship, correlation and regression, Testing of Hypotheses for single sampling: Parametric (t, z and F) Chi Square, ANOVA, and non-parametric tests, numerical problems.						
Unit-V						7 Hours
Essential of Report writing and Ethical issues:						
Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Precautions for Writing Research Reports.						
Syllabus includes 12 hours of tutorials in which:						
<ul style="list-style-type: none"> • Faculty is expected to discuss research methodology for specializations under consideration. • Numerical problems on statistical analysis as required for the domains in which students are studying must be discussed. • Statistical analysis using MINITAB/ MatLab and such other softwares can be introduced. 						

Course Outcomes:

After going through this course the students will be able to

- CO 1. Explain various principles and concepts of research methodology.
- CO 2. Apply appropriate method of data collection and analyze using statistical methods.
- CO 3. Analyze research outputs in a structured manner and prepare report as per the technical and ethical standards.
- CO 4. Formulate research methodology for a given engineering and management problem situation.

Reference Books:

1. Kothari C.R., “Research Methodology Methods and techniques”, New Age International, 2004, ISBN: 9788122415223
2. Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., “Management Research Methodology”, Pearson Education India, 2009 Edition, ISBN:9788177585636
3. Levin, R.I. and Rubin, D.S., “Statistics for Management”, 7th Edition, Pearson Education: New Delhi, ISBN-13: 978-8177585841

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	---	---	M	----	----	---	H	---	H	----
CO2	---	L	H	H	M	M	L	L	----	M	L
CO3	L	M	M	M	H	M	L	M	---	---	M
CO4	H	H	H	H	----	L	L	M	H	---	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	--
CO2	L	--
CO3	L	--
CO4	L	--

HIGHWAY CONSTRUCTION AND MAINTENANCE(Theory and Practice)						
Course Code	:	16MHT22		CIE Marks	:	100+50
Hrs/Week	:	L:T:P:S	4:0:1:0	SEE Marks	:	100+50
Credits	:	05		SEE Duration	:	3 Hrs+3 Hrs
Course Learning Objectives (CLO):						
Student will be able to						
<ol style="list-style-type: none"> 1. Understand the specifications and steps for construction of Embankment, subgrade, subbase, granular, Bituminous and concrete layers 2. Apply the specifications for construction and maintenance of pavement layers. 3. Test for quality of pavement layers during construction and maintenance. 4. Plan the construction and maintenance of pavements. 						
Unit – I						09Hrs
Introduction: Components of pavement structure, functions and requirements, Plants and Equipments : Excavators, graders, compactors, crushers, bituminous hot mix plants, cement concrete mixers, pavers - uses in road construction.						
Unit – II						10Hrs
Construction of Subgrade and Subbase: Specifications and steps for construction of subgrade, subbase, quality control tests						
Construction of granular layers: Specifications and steps of construction , WBM, WMM, CRM, quality control tests						
Construction of Bituminous Layers: Different types of bituminous layers, specifications and construction of bituminous layers, quality control tests						
Unit – III						09Hrs
Construction of Cement Concrete Pavements: 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						
Safety during Construction: Safety aspects during construction and maintenance works, road safety furniture						
Unit – IV						09Hrs
Drainage: 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						
Unit – V						09Hrs
Maintenance: 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.						
Unit – VI (Lab Component)						
Mx Roads Software and HDM 4 software,						
Mx Roads:						
<ol style="list-style-type: none"> 1. Introduction to software 						

2. Horizontal Alignment
3. Vertical Alignment
4. Intersection elements

HDM 4:

1. Introduction
2. Deterioration modeling
3. Economic analysis

Expected Course Outcomes:

After successful completion of this course the student will be able to:

- CO1: Explain the specifications and steps for construction of pavement layers.
 CO2: Select the specifications for construction and maintenance of pavement layers.
 CO3: Examine the quality of pavement layers during construction and maintenance.
 CO4: Construct and maintain the pavements.

Reference Books:

- | | |
|----|--|
| 1. | MoRTH ‘Specifications for Road and Bridge works’ 2013, fifth revision, Indian roads Congress, New Delhi |
| 2. | MoRTH ‘Manual for Construction and Supervision of bituminous Works’, 2001, Indian Roads Congress, New Delhi |
| 3. | 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 , ISBN-10: 0914313010 |
| 4. | Peurifoy RL and Clifford JS ‘Construction Planning Equipment and Method’ (8th Edition) 2010, McGraw Hill Book Co Inc, ISBN:13:978-0073401126. |
| 5. | IRC :15-2011, IRC :14-2004, IRC :35-2015, IRC:67-2012, IRC:109-2015, IRC:111-2009, IRC:120 -2015, IRC:SP:11-1984, IRC:SP:42-2014, IRC:SP:50-2013, IRC :SP: 6-2004, IRC:SP:68-2005, IRC:SP:76-2015, |

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H							L	L	L	
CO2	H				M						
CO3	M								L	L	
CO4	L							L			

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	H	-
CO3	-	L
CO4	-	L

HIGHWAY ECONOMICS						
Course Code	:	16MHT231		CIE Marks	:	100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	:	100
Credits	:	04		SEE Duration	:	03 Hrs
Course Learning Objectives (CLO):						
Student will be able to						
<ol style="list-style-type: none"> 1. Understand the principles of highway economics and finance. 2. Apply economics for different types of highway projects. 3. Analyze for economical and financial feasibility of highway projects. 4. Evaluate techno-economic feasibility of highway projects 						
Unit – I						10Hrs
Introduction- Principle, supply and demand models, equilibrium, sensitivity of travel demand, Elasticities– 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						
Unit – II						10Hrs
Economic analysis- Different methods, determination of annual cost, benefit cost ratio, IRR, FYRR, 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.						
Unit – III						08Hrs
Financing of road projects- Methods, Public Private Partnership(PPP), environmental economics, Toll collection, economic viability PPP projects, risk analysis, case studies						
Unit – IV						10Hrs
Cost Analysis – Introduction, notation, simple and compound interest, uniform series of payments, uniform continuous cash flow and capitalized cost, discrete compound interest factors.						
Unit – V						10Hrs
Application of probability and statistics – Introduction, data analysis and evaluation, sampling, significance testing, regression analysis, queuing models.						
Expected Course Outcomes:						
After successful completion of this course the student will be able to:						
CO1: Explain the principles of highway economics and finance.						
CO2: Solve the highway projects for varying techno – economical conditions.						
CO3: Compare economical and financial feasibility for different alternatives of highway projects.						
CO4: Justify techno-economic feasibility of highway projects						
Reference Books:						
1.	Mc Carthy, P “Transportation Economics”, Blackwell, 2001, ISBN: 978-0-631-22180-7.					
2.	Jotin Chisty.C and Kent Lall B “Transportation Engineering An Introduction”- Prentice – hall					

	of India Private limited, New Delhi, ISBN-81-203-2212-6
3.	Indian Roads Congress, “Manual on economic analysis of highway projects” special publication – 30, New Delhi , 2007
4.	Indian Roads Congress, “Manual for road investment decision model” special publication – 38, New Delhi, 1992
5.	L R Kadiyali, “Traffic engineering and transportation planning” Khanna Publishers, New Delhi, 2008, ISBN: 9780471632658. 3

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M						M	L	L		
CO2	H	M					L				
CO3			M				L		L		
CO4	M						L				

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	-
CO2	M	L
CO3	M	L
CO4	M	-

URBAN PUBLIC TRANSPORT					
Course Code	:	16MHT232		CIE Marks	: 100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	: 100
Credits	:	04		SEE Duration	: 03 Hrs
Course Learning Objectives (CLO):					
Student will be able to					
<ol style="list-style-type: none"> 1. Understand the planning, modes and alternatives of urban public transport. 2. Apply the systems and technologies for efficient and economical urban public transport. 3. Analyze the planning, systems and alternatives of urban public transport. 4. Evaluate and recommend appropriate urban public transport. 					
Unit – I					10Hrs
System and Technologies: 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.					
Unit – II					10Hrs
Comparing Alternatives: Comparing costs, comparative analysis, operational and technological characteristics of different rapid transit modes, evaluating rapid transit, Problems.					
Unit – III					10Hrs
Planning: Transportation system management, system and service planning, financing public transportation, management of public transportation, public transportation marketing.					
Unit – IV					09Hrs
Transit System Evaluation: Definition of quantitative performance attributes, transit lane capacity, way capacity, station capacity, theoretical and practical capacities of major transit modes, quantification of performance, Problems.					
Unit – V					09Hrs
Urban traffic: 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.					
Expected Course Outcomes:					
After successful completion of this course the student will be able to:					
CO1: Summarize the planning, modes and alternatives of urban public transport.					
CO2: Choose the systems and technologies for efficient and economical urban public transport.					
CO3: Compare the planning, systems and alternatives of urban public transport.					
CO4: Judge and propose appropriate urban public transport.					

Reference Books:

1. George E. Gray and Lester A. Hoel, 'Public Transportation', Prentice Hall, New Jersey. ISBN 0-13-726381-3
2. Vukan R Vuchic Urban Transit Systems and Technology, Wiley Publishers ISBN: 978-0-471-75823-5
3. Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss,' City Traffic - A Systems Digest', ISBN 10: 0442292597, Van Nostrand Reinhold Company, New York
4. L R Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers New Delhi ISBN No : 81-7409-220-X

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								L	L		
CO2	H	M									
CO3								L	L		
CO4			M								

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	L
CO2	-	L
CO3	M	L
CO4	-	-

ROAD PROJECTS				
Course Code	: 16MHT241		CIE Marks	: 100
Hrs/Week	: L:T:P:S	4:0:0:0	SEE Marks	: 100
Credits	: 04		SEE Duration	: 03 Hrs
Course Learning Objectives (CLO):				
Student will be able to				
<ol style="list-style-type: none"> 1. Understand the components of road project reports. 2. Identify and carry out the various surveys and investigations for the road projects. 3. Interpret the surveys and investigations for road projects 4. Formulate the report for road projects. 				
Unit – I				09Hrs
Salient features of ongoing road projects in the country , Objects and Scope of Prefeasibility, feasibility and detailed project report for road projects, typical HR structure for preparation of project reports and implementation of road projects.				
Unit – II				10Hrs
Traffic studies and forecasting: Classified traffic volume, origin – destination, speed and delay, parking and pedestrian studies, axle load studies, traffic growth estimate, analysis of data for road geometry and pavement design.				
Unit – III				10Hrs
Topographic Surveys and Road Geometry: Remote sensing and GIS, Topographic survey for road project, geometric design elements, standards and specifications for road projects, road safety audit, inventory of cross drainage structures.				
Unit – IV				10Hrs
Geotechnical and Environmental Impact Assessment : Surveys and investigations for availability and choice of conventional and alternate materials for design and construction, Pavement distress assessment, choice of pavement type, Environmental and social impact assessment studies, mitigation measures				
Unit – V				09Hrs
Economic Evaluation and Project reports: Economic evaluation of different possible alternatives, preparation of BOQ, preparation of drawings, tendering process-types of tender documents, tender evaluation, preparation of final project reports, Use of HDM-4 Software, Use of Mx roads software..				
Expected Course Outcomes:				
After successful completion of this course the student will be able to:				
CO1: Explain the components of road project reports.				
CO2: Choose and execute various surveys and investigations for the road projects.				
CO3: Analyze the surveys and investigations for road projects				
CO4: Prepare the report for road projects.				
Reference Books:				
1.	IRC:SP:19-2001 ‘Manual for Survey, investigation and Preparation of Road Project’ 2001, Indian Roads Congress, New Delhi			
2.	IRC:84:2014 ‘Manual for Specifications and standards for four laning of Highways through Public Private Partnership, Indian Roads Congress, New Delhi			

3.	IRC:SP:30: 2009 ‘Manual on Economic Evaluation of Highway Projects in India’ Indian Roads Congress, New Delhi
4.	MoRTH ‘Model Concession Agreement for Small Road Projects-2000, Indian Road Congress, New Delhi
5.	IRC:87-2013, IRC:SP:88-2010, IRC:SP:93-2011, IRC:SP:96-2012, IRC:SP:97-2013, IRC:SP:97-2013,

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								L			
CO2	H							L			
CO3		M						L			
CO4			H						L		

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	-	L
CO3	-	L
CO4	H	-

ROAD SAFETY ENGINEERING					
Course Code	:	16MHT242		CIE Marks	: 100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	: 100
Credits	:	04		SEE Duration	: 03 Hrs
Course Learning Objectives (CLO):					
Student will be able to					
<ol style="list-style-type: none"> 1. Understand the various aspects of road safety. 2. Identify the factors affecting road safety. 3. Apply and analyze the engineering factors for safety. 4. Evaluate and propose mitigative measures for safety. 					
Unit – I					09Hrs
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.					
Unit – II					10Hrs
Data Collection and analysis					
Statistical Interpretation and Analysis of Crash Data: Before-after methods in crash analysis, statistical methods, Black Spot Identification & Investigations, Case Studies.					
Unit – III					10Hrs
Road Safety Audits					
Key elements of a road safety audit, Road Safety Audits & Investigations, Crash investigation and analysis, Describe methods for identifying hazardous road locations, Case Studies.					
Unit – IV					09Hrs
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.					
Unit – V					09Hrs
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.					
Expected Course Outcomes:					
After successful completion of this course the student will be able to:					
<p>CO1: Describe the factors affecting road safety.</p> <p>CO2: Explain the various aspects of road safety.</p> <p>CO3: Examine the engineering factors for safety.</p> <p>CO4: Recommend mitigative measures for safety.</p>					

Reference Books:

1. Martin Belcher, Steve Proctor, and Phil Cook” Practical Road Safety Auditing”, 3rd Edition, ICE Publishing, USA, 2015, ISBN: 9780727760166.
2. Belche Mr, Proctor and Cook P” Practical Road safety auditing”, 2nd Edition, 2008, Publishers-Thomas Telford Limited, London, ISBN: 9780727735157.
3. Leonard Evans ”Traffic Safety”, Science Serving Society of Bloomfield Hills, Michigan, 2004, ISBN-10: 0975487108.
4. Ezra Hauer, ” Observational Before-After Studies in Road Safety”, Emerald Group Publishing Limited (February 1, 1997) ISBN-13: 978-0080430539.
5. Institute of Transportation Engineers (ITE), ” The Traffic Safety Toolbox: A Primer on Traffic Safety”, Publishers- Institute of Transportation Engineers, USA, ISBN No: 0-935403-91-4, 1999.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H							L			
CO2								L	L		
CO3		M							L		
CO4			M							L	

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	L
CO2	-	L
CO3	M	-
CO4	M	-

ROAD CONSTRUCTION PLANNING AND MANAGEMENT					
Course Code	:	16MHT251		CIE Marks	: 100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	: 100
Credits	:	04		SEE Duration	: 03 Hrs
Course Learning Objectives (CLO):					
Student will be able to					
<ol style="list-style-type: none"> 1. Understand the broad features of road construction planning and management. 2. Plan the resources for road construction. 3. Estimate and analyze the resources required for road construction. 4. Formulate the planning and management for road construction 					
Unit – I					08Hrs
Project Management Framework: Types and Scope of highway development projects, project management framework, scope and project objectives, project development process, causes of project failure.					
Unit – II					10Hrs
Project Scheduling: Project work breakdown, determining activities involved, assessment involved, CPM/ PERT network analysis, work scheduling, methods of work scheduling, factors affecting work scheduling, optimization.					
Unit – III					09Hrs
Resource Planning : human resources, project man power grouping, structuring site organisation, construction materials – provisioning process, inventory management, cost and budget					
Unit – IV					09Hrs
Construction Equipment: task, cost and engineering considerations, equipment acquisition options, selection site for site office, crushing and mixing plants,					
Unit – V					07Hrs
Planning control system: Resource production, controlling scheduling, codification, project management information system, value management					
Expected Course Outcomes:					
After successful completion of this course the student will be able to:					
CO1: Explain features of road construction planning and management.					
CO2: Choose resources for road construction.					
CO3: Evaluate the resources required for road construction.					
CO4: Propose resource planning and control system for road construction.					
Reference Books:					
1.	K K Chitkara ‘Construction project management planning, scheduling and controlling’ (Third Edition) June 2014, Tata Mc Graw hill Publications. ISBN-13: 978-9339205447.				
2.	Peurifoy RL and Clifford JS ‘Construction Planning Equipment and Method’ (8 th Edition) 2010, McGraw Hill Book Co Inc, ISBN: 13:978-0073401126.				
3.	SC Sharma ‘Construction Equipment and its Management’ 2002, Khanna Publishers, ISBN-13:978-8174091376.				

4. IRC:SP:84-2012, IRC:SP:87-2012, IRC:SP:96-2012, IRC:SP:97-2013

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H							L	L		
CO2	M							L			
CO3	M								L		
CO4			H								

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	L
CO2	-	-
CO3	M	-
CO4	H	-

ROAD CONSTRUCTION EQUIPMENT					
Course Code	:	16MHT252		CIE Marks	: 100
Hrs/Week	:	L:T:P:S	4:0:0:0	SEE Marks	: 100
Credits	:	04		SEE Duration	: 03 Hrs
Course Learning Objectives (CLO):					
Student will be able to					
<ol style="list-style-type: none"> 1. Understand the broad features of road construction equipment 2. Plan construction equipments for road construction 3. Analyze and estimate the productivity of the equipments 4. Develop equipment spread for road construction 					
Unit – I					05Hrs
Introduction					
Importance of plants and equipments – advantages and limitations, types of construction equipment,					
Unit – II					10Hrs
Equipment for earthwork, hauling and spreading					
Dozers, excavators, loaders, hauling units, graders – application, types, production, factors effecting the production					
Unit – III					10Hrs
Plants for productions of aggregates and mixes					
Crushers- types, factors effecting the production, Pug mill for production wet mix macadam, Hot bituminous mix plants – types, production process, Concrete batching plant- cement concrete production process					
Unit – IV					10Hrs
Paving and Compacting Equipment					
Pavers – components, types of pavers, factors influencing paving quality, , Compactors – types, application, Miscellaneous equipment – Kerb casting equipment, road marking equipment, bitumen sprayers					
Unit – V					10 Hrs
Equipment Management					
Forecasting equipment requirement, maintenance of equipment, selection of construction equipment- task considerations, cost considerations, equipment acquisition options					
Expected Course Outcomes:					
After successful completion of this course the student will be able to:					
CO1: Explain the features of road construction equipment					
CO2: Choose construction equipments for road construction					
CO3: Analyze the productivity of the equipments.					
CO4: Select equipment spread for road construction.					

Reference Books:

1	Peurifoy RL and Clifford JS ‘Construction Planning Equipment and Method’ (8 th Edition) 2010, McGraw Hill Book Co Inc, ISBN: 13:978-0073401126.
2	SC Sharma ‘Construction Equipment and its Management’ 2002, Khanna Publishers, ISBN-13:978-8174091376
3	K K Chitkara ‘ Construction project management planning, scheduling and controlling’ (Third Edition) June 2014, Tata Mc Graw hill Publications. ISBN-13: 978-9339205447.
4	IRC SP:96-2012, ‘Guidelines for selection, operation and maintenance of concrete batching and mixing plants’ Indian Roads Congress, New Delhi
5	IRC -97-2013 ‘Guidelines on Compaction Equipment for Road Works’ Indian Road Congress, New Delhi
6	IRC-SP:86:2010, IRC SP:39-1192, websites of equipment manufacturers

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								L	L		
CO2	M										
CO3								L	L		
CO4			H								

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	L
CO3	M	-
CO4	H	-

MINOR PROJECT					
Course Code	:	16 MHT26		CIE Marks	: 100
Hrs/Week	:	L:T:P:S	0:0:10:0	SEE Marks	: 100
Credits	:	05		SEE Duration	: 3 Hours
Course Learning Objectives:					
Students are able to					
<ol style="list-style-type: none"> 1. Understand the method of applying engineering knowledge to solve specific problems. 2. Apply engineering and management principles while executing the project 3. Demonstrate the skills for good presentation and technical report writing skills. 4. Identify and solve complex engineering problems using professionally prescribed standards. 					
GUIDELINES					
<ol style="list-style-type: none"> 1. Each project group will consist of maximum of two students. 2. Each student / group has to select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey. 3. Allocation of the guides preferably in accordance with the expertise of the faculty. 4. The number of projects that a faculty can guide would be limited to four. 5. The minor project would be performed in-house. 6. The implementation of the project must be preferably carried out using the resources available in the department/college. 					
Course Outcomes:					
After going through this course the students will be able to					
CO1: Conceptualize, design and implement solutions for specific problems.					
CO2: Communicate the solutions through presentations and technical reports.					
CO3: Apply resource managements skills for projects					
CO4: Synthesize self-learning, team work and ethics.					

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of FOUR members : guide, two senior faculty members and Head of the Department.

Phase	Activity	Weightage
I	Synopsis submission, Preliminary seminar for the approval of selected topic and Objectives formulation	20%
II	Mid-term seminar to review the progress of the work and documentation	40%
III	Oral presentation, demonstration and submission of project report	40%

****Phase wise rubrics to be prepared by the respective departments**

CIE Evaluation shall be done with weightage / distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing 25%
- Demonstration & Presentation 15%
- Report writing 25%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Presentation / Demonstration of the project 20%
3. Methodology and Experimental Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	H	H	H	---	---	M	---	H	H
CO2	----	---	----	---	H	----	---	H	H	H	----
CO3	H	H	M	---	M	M	H	H	---	M	H
CO4	---	H	----	---	----	H	M	M	M	H	---

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	L
CO2	M	L
CO3	M	M
CO4	M	L

Rashtreeya Sikshana Samithi Trust

R.V. College of Engineering

(Autonomous Institution Affiliated to VTU, Belagavi)



Department of Civil Engineering

Master of Technology (M. Tech.)

HIGHWAY TECHNOLOGY

**Scheme and Syllabus of
Autonomous System w.e.f 2016**

R.V. College of Engineering, Bengaluru – 59
(Autonomous Institution Affiliated to VTU, Belagavi)
M. Tech. Highway Technology
Department of Civil Engineering

Vision: Excel in Education, Research and Consultancy in Civil Engineering with emphasis on sustainable Development

Mission:

1. Disseminating and integrating the knowledge of structural, transportation, environmental and geotechnical engineering
2. Enhancing Industry – Institute interaction leading to Interdisciplinary research
3. Imbibing wide range of skills in cutting edge technology for sustainable development
4. Motivate entrepreneurship and professional ethics to serve the society

Program: HIGHWAY TECHNOLOGY

Program Educational Objectives (PEO)

M. Tech. in Highway Technology Program, graduates will be able to:

1. Analyze, design, construct, evaluate and maintain bituminous, concrete and composite pavements.
2. Exhibit professionalism in consultancy, entrepreneurship and academics in highway technology.
3. Engage in lifelong learning through research including association with professional societies.
4. Adopt sustainable and inclusive technologies to address societal needs.

Program Outcomes (PO)

M. Tech. in Highway Technology graduates will be able to:

PO1: Scholarship of Knowledge – Acquire in depth knowledge of highway technology, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge and integration of same for enhancement of Knowledge

PO 2: Critical Thinking – Analyze complex highway engineering problems critically, apply independent judgement for synthesizing information to make intellectual and or creative advances for conducting research in theoretical, practical and policy context.

PO3: Problem Solving – Think laterally and originally, conceptualize and solve highway technological problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors.

PO4: Research Skill – Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually / in groups to the development of scientific / technological knowledge in one or more domains of materials, design, construction, maintenance and management of pavements.

PO5: Usage of Modern tool – Create, select, learn and apply appropriate techniques, resources and modern engineering and software for prediction and modeling of pavement performances.

PO6: Collaborative and multidisciplinary research – Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative multi-disciplinary scientific research, demonstrate capacity for self-management and team work, decision making based on open mindedness, objectivity and rational analysis in order to achieve common goals and further learning of themselves as well as others

PO7: Project management and Finance- Demonstrate knowledge and understanding of highways and project management and apply the same to one's own work as a member and leader in team, manage projects efficiently in highway technology and inter-disciplinary environments after consideration of economic and financial factors

PO8: Communication – Communicate with the engineering community and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations and give and receive clear instructions.

PO9: Life Long Learning – Recognize the need for, and have the preparation and ability engage in lifelong learning independently, with high level of enthusiasm and commitment to improve knowledge and competence continuously

PO10: Ethical Practices and Social responsibility – Acquire and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of

research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society

PO11 Independent and reflective thinking – Observe and examine critically outcome of ones actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

Program Specific Criteria (PSC)

Lead Society: American Society of Civil Engineers

1. Curriculum

The program prepares students for professional, teaching and research careers. Emphasis is on the acquisition of knowledge concerning planning, design, construction, maintenance, management and evaluation of highway facilities with due consideration to public governing policies and guidelines.

2. Faculty competency

Faculties are qualified with post graduate and doctoral degrees in the stream of highway and transportation engineering. The faculties are actively publishing research papers in reputed national and international journals related to highway and transportation engineering. The faculty are also actively involved in industrial consultancy and associated with professional bodies.

Program Specific Outcomes (PSO)

M. Tech. in Highway Technology graduates will be able to:

- PSO 1.** Apply knowledge of materials, analysis and design for construction, maintenance and management of pavements.
Demonstrate the ability to carry out pavement surveys and investigations for road projects.

R. V. College of Engineering, Bengaluru – 59.*(An Autonomous Institution affiliated to VTU, Belagavi)***Department of Civil Engineering****M. Tech. Highway Technology**

THIRD SEMESTER								
Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture	Tutorial	Practical	Experiential Learning	
				L	T	P	S	
1	16MHT31	Pavement Deterioration and Evaluation (Theory & Practice)	CV	4	0	1	0	5
2	16MHT32X	Elective -5	CV	4	0	0	0	4
3	16MHT33X	Elective -6	CV	4	0	0	0	4
4	16MHT34X	Elective -7	CV	4	0	0	0	4
5	16MHT35	Internship/ Industrial Training	CV	0	0	3	0	3
6	16MHT36	Technical Seminar	CV	0	0	2	0	2
		Total		16	0	6	0	22

Elective 5			
16MHT321	Pavement Management System	16MHT322	Intelligent Transport System
Elective 6			
16MHT331	Special Problems in Road Construction	16MHT332	Transportation Planning
Elective 7			
16MHT341/ 16MST341	Design of Bridges, flyovers and grade separators	16MHT342/ 16MST342	Earth Retaining structures

R. V. College of Engineering, Bengaluru – 59.*(An Autonomous Institution affiliated to VTU, Belagavi)*

Department of Civil Engineering

M. Tech. Highway Technology

FOURTH SEMESTER								
Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture	Tutorial	Practical	Experiential Learning	
				L	T	P	S	
1	16MHT41	Major Project	CV	0	0	26	0	26
2	16MHT42	Seminar	CV	0	0	2	0	2
		Total		0	0	28	0	28

Credit Distribution

Category	Min	Max	Recommended	RVCE
Core (incl. soft core)	15	25	20	32
Elective	25	35	30	28
Project Work	30	45	40	32
Internship/industrial -Field work	3	5	5	3
Seminar	3	5	5	5
TOTAL			100	100

III SEMESTER

PAVEMENT DETERIORATION AND EVALUATION (Theory & Practice)					
Course Code	:	16MHT31		CIE Marks	: 100+50
Hrs/Week	:	L:T:P:S 4:0:1:0		SEE Marks	: 100+50
Credits	:	05		SEE Duration	: 3 Hrs+3Hrs
Course Learning Objectives (CLO): Student will be able to					
1	Discuss structural and functional adequacies of flexible and rigid pavements				
2	Estimate functional and structural deterioration of pavements, overlay types, semifield studies				
3	Interpret pavement condition, distress and overlay techniques				
4	Compare different pavement deterioration and evaluation techniques				
UNIT – I					09Hrs
Introduction: Structural and functional requirements of flexible and rigid pavements, different types, causes and remedial measures of failures in flexible and rigid pavements.					
UNIT – II					10Hrs
Pavement surface condition evaluation – requirements, Causes, effects, methods of measurement / evaluation and treatment of: Pavement slipperiness, Riding quality and unevenness, Rating techniques, use of modern equipments for equipment for pavement surface condition measurements, analysis of data, interpretation and application.					
UNIT – III					10Hrs
Structural evaluation of pavements: requirements, factors affecting structural condition, causes, effects, methods of structural evaluation of flexible pavements by Benkelman beam deflection method, FWD, analysis of data, importance of deflection bowl measurements, interpretation and applications, design of overlay. "Use of FWD and other methods for evaluation of flexible and rigid pavements and their application. Problems					
UNIT – IV					10Hrs
Overlay design: as per IRC:81-1997, choice of overlay type and pavement materials over existing flexible and rigid pavements, use of white topping, ultra thin white topping, thin white topping and ICBP as overlays					
UNIT – V					09Hrs
Model pavement studies, pavement testing Under controlled conditions, accelerated testing and evaluation methods. Test track studies. Instrumentation for pavement testing					
UNIT – VI (Lab Component)					
1. Determination of Roughness using fifth wheel bump integrator and MERLIN					
2. Pavement distress surveys to evaluate pavement condition through PCI, PSI and PCR					
3. Determination of texture Depth of pavements					
4. Structural evaluation of pavements using Benkelman Bump Integrator					
Expected Course Outcomes: After successful completion of this course the student will be able to:					
1	Explain structural and functional adequacies of flexible and rigid pavements				
2	Analyze functional and structural deterioration of pavements, overlay types, semifield studies				

3	Categorize pavement condition, distress and overlay techniques
4	Summarize different pavement deterioration and evaluation techniques

Reference Books:

1.	E.J.Yoder & Witzczak M.W. “Principles of Pavement Design”- 2 nd Edition – John Willey and Sons Inc., New York, 1975, ISBN: 978-0-471-97780-3
2.	Hass R., Hudson. W. R., Zaniewisti J. “Modern Pavement Management” – Krieger Publishing Company, Florida, 1994, ISBN: 9780070308954
3.	Per Ullitz “Pavement Analysis” - Elsevier Amsterdam, ISBN: 0-620-22376-6
4.	David and Paul Croney, “Design and performance of road pavements”- third edition, Mc Graw hill, 1998, ISBN-10: 0070144516; ISBN-13: 978-0070144514

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	-	-	-	-	-	-	-	-
CO2	H	H	M	-	L	-	-	L	-	-	-
CO3	H	H	-	-	-	-	-	-	H	-	-
CO4	H	H	M	H	-	-	-	L	H	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	M	-
CO3	H	-
CO4	H	-

PAVEMENT MANAGEMENT SYSTEM (Elective 5)			
Course Code:	16MHT321		CIE Marks: 100
Hrs/Week:	L:T:P:S:: 4:0:0:0		SEE Marks: 100
Credits:	04		SEE : 3 Hrs
Course objectives: This course will enable students to			
1	Understand the need and components of Pavement Management System		
2	Explain structural and functional evaluation of pavements		
3	Evaluate pavement distresses for pavement modelling		
4	Develop a framework for efficient pavement management system		
UNIT – I			
Introduction: components and principles of pavement management systems, pavement maintenance measures, planning investment, research management Pavement performance evaluation: general concepts, serviceability, pavement distress survey systems, performance evaluation			09 Hours
UNIT – II			
Pavement Performance Prediction: concepts, modeling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models. Functional condition deterioration models, unevenness prediction models and other models, comparison. Modeling in rehabilitation, budget planning, problems.			10 Hours
UNIT – III			
Design alternatives and selection: Design objectives and constraints, basic structural response models, physical design inputs, alternate pavement design strategies and economic evaluation, reliability concepts in pavement engineering, life cycles costing, analysis of alternate pavement strategies based on distress and performance and problems.			10 Hours
UNIT – IV			
Ranking and optimization methodologies: recent developments, sample size selection, economic optimization of pavement maintenance and rehabilitation. Expert Systems in Pavement Management: applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge-based expert systems.			10 Hours
UNIT – V			
Implementation and application of Pavement Management Systems.- Introduction-major steps-Maintenance Management. and Scheduling.			09 Hours
Course outcomes: After studying this course, students will be able to:			
1	Explain the need of PMS in planning and maintaining the pavements		
2	Analyse the performance of pavements, causes of failure, rating methods		
3	Evaluate the of models for pavement management		
4	Develop the PMS for different levels		
Reference Books:			
1	Ralph Haas and Ronald W. Hudson, 'Pavement Management System', McGraw Hill Book Co. 1978, ISBN. 0070253919		

2	Ralph Haas, Ronald Hudson Zanieswki. 'Modern Pavement Management, Kreiger Publications, New York, 1992, ISBN, 0894645889, 9780894645884
3	Proceedings of North American Conference on Managing Pavement, USA, 2004,
4	Proceedings of International Conference on Structural Design of Asphalt Pavements NCHRP, TRR and TRB Special Reports, USA, 2006
5	William D. O. Paterson, 'Road Deterioration and Maintenance Effects, Models for Planning and Management', The Highway Design and Maintenance Standards series, A World Bank Publication, June 1990, ISBN-10: 0801835909;ISBN-13: 978-0801835902

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	-	-	-	-	-	L	-	-	-
CO2	H	H	H	-	-	-	L	-	-	-	-
CO3	H	-	H	H	-	-	L	-	M	-	-
CO4	H	H	-	H	L	-	M	L	M	-	M

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	H
CO2	M	-
CO3	M	-
CO4	-	H

INTELLIGENT TRANSPORTATION SYSTEM(Elective 5)		
Course Code:	16MHT322	CIE Marks: 100
Hrs/Week:	L:T:P:S ::4:0:0:0	SEE Marks: 100
Credits:	04	SEE : 3 Hrs
Course Learning Objectives (CLO): Graduates shall be able to		
1	Discuss the fundamental concepts of ITS	
2	Describe the design and implementation	
3	Identify functional areas, user needs and services in ITS	
4	Compare ITS standards and applications	
UNIT – I		09 Hrs
Introduction – Definition, Historical Background, Objectives, Benefits, elements, Definitions/Functions and Purpose.		
UNIT – II		10Hrs
Technology: Selection of methodologies, data collection and processing, control, decision systems, simulation, real-time systems, car for the future, intelligent vehicle sensor technologies, microcontrollers and micro-electronic technology, vehicle optical sensor, radio frequency technologies for vehicle information systems, global positioning technology, intelligent vehicle detection and control technologies, Case Studies.		
UNIT – III		10Hrs
Functional areas: 1. Advanced traffic management systems (ATMS); 2. Advanced traveler information systems (ATIS); 3. Commercial vehicle operations (CVO); 4. Advanced public transportation systems (APTS); 5. Advanced rural transportation systems (ARTS); 6. Advanced vehicle control systems (AVCS), Case Studies.		
UNIT – IV		10Hrs
User Needs and Services: Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.		
UNIT – V		09 Hrs
ITS Standards and Applications: ITS architecture and standards -Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.		
Expected Course Outcomes: After studying this course, students will be able to:		
1	Explain appropriate ITS technology depending upon site specific conditions	
2	Compare different ITS user services	
3	Interpret ITS architecture and standards	
4	Design and implement ITS components	

Reference Books:

1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House publishers (31 March 2003); ISBN-10: 1580531601
2. Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola “Intelligent Transport Systems: Technologies and Applications” Wiley Publishing ©2015, ISBN:1118894782 9781118894781
3. ITS Hand Book 2000 Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
4. Dominique Luzeaux ,Jean-René Ruault, Michel Chavret “Intelligent Transport Systems” 7 MAR 2013 Copyright © 2010 by John Wiley & Sons, Inc DOI: 10.1002/9781118557495.
5. Sussman, J. M., “Perspective on Intelligent Transport Systems”, Artech House Publishers, 2005 ISBN-13: 978-0387232577.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	H	-	-	-	-	-	-	-	-
CO2	H	H	H	-	-	-	-	-	-	-	-
CO3	H	H	H	-	M	-	-	-	M	M	-
CO4		H	-	M	M	M	-	-	M	M	M

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	H	-
CO3	H	-
CO4	M	-

SPECIAL PROBLEMS IN ROAD CONSTRUCTION (Elective 6)			
Course Code:	16MHT331		CIE Marks: 100
Hrs/Week:	L:T:P:S 4:0:0:0		SEE Marks: 100
Credits:	04		SEE : 3 Hrs
Course objectives: This course will enable students to			
1	Discuss the problems encountered during road construction along unstable soils		
2	Describe the methods of strengthening soil fills and embankments to improve their performance as pavement component layer		
3	Identify the difficulties associated with construction of high embankments and maintaining stability of hill slopes with precautions to be taken		
4	Discover the use of recycled materials in road construction including milled bituminous waste with necessary design methodology		
UNIT – I			
Construction of roads in problematic soils and water logged areas Various effective measures for solving the problems, machinery required and method of construction. Control of water table, capillary cut off and seepage flow in road construction. Design and construction of filter drains.			09 Hrs
UNIT – II			
Methods of strengthening weak foundation soil- acceleration of consolidation and settlement of compressible embankment foundation using vertical sand drains - application, design and construction method.			10 Hrs
UNIT – III			
Problems in construction of high embankments- settlement and stability of embankment, foundation. Stability of hill slopes, control of erosion.			10 Hrs
UNIT – IV			
Use of special materials - 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.			10 Hrs
UNIT – V			
Special construction techniques - 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, road construction on high altitudes, hilly and mountainous terrain.			09 Hrs
Course outcomes:			
After studying this course, students will be able to:			
1	Explain the difficulties of road construction in weak and marshy soils and the precautions to be taken		
2	Choose improvement methods of strengthening soil fills and embankments for pavement layers		
3	Analyze the difficulties associated with construction of high embankments and maintaining hill slopes stability		

4	Evaluate the use of recycled materials in road construction with appropriate design methods, construction methods for roads in coastal and desert environments
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Reference Books:

1	R.M. Koerner “Designing with Geosynthetics”- 4th Edition Prentice Hall, New Jersey, 1997, ISBN-13: 978-0131454156, ISBN-10: 0131454153.
2	IRC-75 “Guidelines for the design of High embankments”- IRC, 1979
3	DSIR “Soil Mechanics for Road Engineers”- HMSO, London, 1954, ISBN: 9780115502781.
4	Leonards G.A. “Foundation engineering”- McGraw Hill Book Company, New York, 1962, ISBN-10: 0070371989; ISBN-13: 978-0070371989.
5	Cedgreen H.R. “Drainage of highway and airfield pavement”- John Willey and Sons.Inc., New York, 1974, ISBN : 1560512636.
6	G. Kassiff M. Livnet. G. Wisemen “Pavements on Expansive clays”- Jerusalem Academy Press, Jerusalem. Israel, 1969.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	-	-	-	-	-	-	-	-	-
CO2	H	M	H	-	-	-	-	-	-	-	-
CO3	H	M	H	H	-	-	-	-	M	M	-
CO4	M	H	H	H	-	-	-	-	M	M	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	M	-
CO3	M	-
CO4	H	-

TRANSPORTATION PLANNING(Elective 6)			
Course Code:	16MHT332		CIE Marks: 100
Hrs/Week:	L:T:P:S :: 4:0:0:0		SEE Marks: 100
Credits:	04		SEE : 3 Hrs
Course Learning Objectives: This course enables students to			
1	Describe the planning process for an effective transportation system.		
2	Discuss the characteristics of mass transit system and methods of collecting traffic data to propose an effective transport facility.		
3	Analyze transport system for assigning travel trips to various routes for effective management.		
4	Compare the mass transportation options and evaluation of the systems for economic sustainability.		
PART-A			
UNIT – I			
			10Hrs
Introduction: Characteristics of different modes of transportation; Principles of co-ordination and operation control, Elements in urban transit system, NUTP			
Transportation Planning Process: Factors to be considered; land use transportation planning; Systems approach, integration of transport planning, traffic and land use planning			
UNIT – II			
			10Hrs
Transport studies: Planning of different types of surveys and interpretation, travel demand and forecasting Traffic surveys for mass transit system planning.			
UNIT – III			
			10Hrs
Trip Generation and Distribution: Factors governing trip generation and attraction; Zonal models; Category analysis; Methods of trip distribution; Application of gravity model.			
UNIT – IV			
			09Hrs
Modal Split and Assignment: Factors affecting modal split; Modal split in transport planning; principles of traffic assignment; Assignment techniques , integration of multimodal transport systems			
UNIT – V			
			09Hrs
Evaluation: Identification of corridor; Formulation of plans; Economic Evaluation.			
Mass Transit Systems: capacity, Fleet planning and Scheduling, introduction to transportation planning models using softwares.			
Course outcomes:			
After studying this course, students will be able to:			
1	Explain planning process for an effective transportation system		
2	Compare the characteristics of mass transit system and methods of collecting traffic data to propose an effective transport facility		
3	Calculate zonal trip generation and attraction for inter-zonal trip distribution methods		
4	Evaluate transport system for assigning travel trips to various routes for effective management and		

	economic sustainability
Reference Books	
1.	L R Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, ISBN 139788174092205, 2011.
2.	Ponnuswamy S, Johnson Victor D “Urban Transportation: Planning, Operation and Management”, 1st Edition, McGraw Hill Education (India) Private Limited, ISBN-9781259002731, 2012.
3.	JotinKhisty and Kent Lall B“Transportation Engineering –An Introduction- PHI, New Delhi, 3rd Indian Edition, ISBN-13: 978-0130335609, 2006.
4.	Papacostas, C.A, Prevedouros P D “Transportation Engineering and planning”, Pearson Education India, 3rd Edition, ISBN-13: 978-0130814197, 2000.
5.	Hutchinson, B.G., ‘Principles of Urban Transport System Planning’ - McGraw-Hill Inc.,US , ISBN-13: 978-0070315396,1974.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	H	-	-	-	-	L	-	-	-
CO2	H	H	M	-	-	-	-	-	-	-	-
CO3	H	H	M	M	-	-	-	-	-	L	M
CO4	H	H	M	M	-	-	M	-	L	L	M

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	M	-
CO3	H	-
CO4	H	-

DESIGN OF BRIDGES, FLYOVERS AND GRADE SEPARATORS (Elective 7)			
Course Code:	16MHT341		CIE Marks: 100
Hrs/Week:	L:T:P:S:: 4:0:0:0		SEE Marks: 100
Credits:	4+0+0+0		SEE : 3 Hrs
Course objectives: This course will enable students to			
1	Describe the types and components of a bridge with specifications for designing them for highways		
2	Discuss the use of different types of bridge bearings, their installation and maintenance aspects under the action of vehicular loads		
3	Examine the design aspects of bridge approaches for RCC, PSC and Steel bridges		
4	Analyze the loading conditions on the bridges and design the elements as per IRC load specifications		
5	Identify the quality control measures during the execution of bridges both for substructure and super structure portions of the bridge		
UNIT – I			
Introduction: Historical Developments, Site Selection for Bridges, Classification of Bridges Forces on Bridges. Bridge substructures: Abutments, wing walls			09 Hrs
UNIT – II			
Box Culvert: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF, Structural Design of Slab Culvert, with Reinforcement Details.			10 Hrs
UNIT – III			
T Beam Bridge Slab Design: Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail. T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading A Loads, Structural Design of Beam, with Reinforcement Detail.			10 Hrs
UNIT – IV			
Importance of Bearings – Types of bearings, Bearings for slab bridges – Bearings for girder bridges – Design of Elastomeric bearing – Joints – Expansion joints, repair and rehabilitation of concrete bridges.			10 Hrs
UNIT – V			
PSC Bridges: Introduction to Pre and Post Tensioning, Proportioning of Components, Analysis and Structural Design of Slab, Analysis of Main Girder using COURBON's Method for IRC Class AA tracked vehicle, Calculation of pre-stressing force and eccentricity, cable profile and calculation of stresses, Design of End block and detailing of main girder			09 Hrs
Course outcomes: After studying this course, students will be able to:			

1	Explain the components of a bridge following the specifications for highways
2	Compare different types of bridge bearings, their installation and maintenance aspects under the action of vehicular loads
3	Analyse the IRC loading conditions for the design of bridges
4	Evaluate the design aspects of bridge approaches for RCC, PSC and Steel bridges

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Reference Books:

1	D.Johnson Victor, “Essentials of bridge Engineering”- Oxford, IBH publishing company, ISBN, 8120417178, 9788120417175
2	Ponnuswamy, “Bridge Engineering”-McGraw Hill Publication, 1989, ISBN-10: 0070656959
3	Vazirani Ratwani & M.G.Aswani, “Design of Concrete Bridges”- Khanna Publishers, 2004 New Delhi, ISBN-13. 978-81-7409-117-3. ISBN-10
4	Design of Bridges”- Dr. Krishna Raju, Oxford & IBH Publishing company Limited, 2001, ISBN978-81-204-1741-0 788120 114 17410

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	-	-	-	-	-	L	-	-	-
CO2	H	M	H	-	-	-	-	-	-	H	-
CO3	H	H	H	-	-	-	-	-	-	H	H
CO4	H	H	H	H	-	-	-	-	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	H	-
CO3	H	-

	CO4	H	-	
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EARTH RETAINING STRUCTURES (Elective 7)			
Course Code:	16MHT342		CIE Marks: 100
Hrs/Week:	L:T:P :S :: 4:0:0:0		SEE Marks: 100
Credits:	04		SEE : 3 Hrs
Course Learning Objectives:			
1	Understand the significance of earth retaining structures in Civil Engineering applications		
2	Evaluate the lateral earth pressures associated with different earth systems		
3	Analyse the different types of earth retention system		
4	Design the earth retaining structures used for support of fills and excavations		
PART-A			
UNIT – I			
Earth Pressure Theories : Introduction – State of stress in retained soil mass – Earth pressure theories –Classical and graphical techniques – Active and passive cases – Earth pressure due to external loads, empirical methods, Wall movement.			10Hrs
UNIT – II			
Compaction, Drainage and Stability of retaining Structures Retaining structure – Selection of soil parameters , Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. Earth pressure due to earthquake forces , Stability of retaining structure.			09Hrs
UNIT – III			
Sheet Pile Walls Retaining structure – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls. Dead man and continuous anchor. Diaphragm and bored pile walls – Design requirements.			09Hrs
UNIT – IV			
Supported Excavations Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos ,Soil anchors, Soil pinning , Soil nailing – Basic design concepts			10Hrs
UNIT – V			
Design Of Reinforced Earth Retaining Wall Reinforced earth retaining wall – principles, Concepts and mechanism of reinforced Earth – Design consideration of reinforced earth – Materials used in reinforced earth - Geotextile – Geogrids, Metal strips, facing elements.			10Hrs
Course outcomes:			
After going through this course the student will be able to:			
1	Enumerate the types of earth retention system		
2	Predict the Suitability of earth system for a particular project		
3	Quantify the lateral earth pressures associated with different earth systems		

4	Select the most technically appropriate and cost-effective type of retaining wall for the application																																																												
Reference Books																																																													
1	R F Craig, “Soil Mechanics”, Van Nostrand Reinhold International publication, ISBN 10: 0278000193 ISBN 13: 9780278000193																																																												
2	Chris R.I. Clayton, Rick I. Woods, Andrew J. Bond, Jarbas Milititsky “Earth pressure and Earth retaining structures”, Third edition, CRC Press, 2014 ISBN 9781466552111																																																												
3	Koerner, R.M., “Design with Geosynthetics” Sixth Edition, Prentice Hall, 2012. ISBN-13: 978-1462882892 ,10: 1462882897																																																												
4	Das, B.M.,” Principles of Geotechnical Engineering” Fourth Edition, The PWS series in Civil Engineering, 1998 ISBN-10: 0534951791 ,ISBN-13: 978-0534951795																																																												
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	PSO1	PSO2																																																											
CO1	H	-																																																											
CO2	-	M																																																											
CO3	M	-																																																											
CO4	L	-																																																											

INTERNSHIP / INDUSTRIAL TRAINING						
Course Code	:	16MHT35		CIE Marks	:	100
Hrs/Week	:	L:T:P:S	0:0:6:0	SEE Marks	:	100
Credits	:	3		SEE Duration	:	30 min
GUIDELINES FOR INTERNSHIP						
Course Learning Objectives (CLO):						
The students shall be able to:						
1	Understand the process of applying engineering knowledge to produce product and provide services.					
2	Explain the importance of management and resource utilization.					
3	Comprehend the importance of team work, protection of environment and sustainable solutions.					
4	Imbibe values, professional ethics for life long learning.					
<ol style="list-style-type: none"> 1) The duration of the internship shall be for a period of 8 weeks on full time basis between II semester final exams and beginning of III semester. 2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature. 3) Internship must be related to the field of specialization or the M.Tech program in which the student has enrolled. 4) Students undergoing internship training are advised to use ICT tools such as skype to report their progress and submission of periodic progress reports to the faculty members. 5) Every student has to write and submit his/her own internship report to the designated faculty. 6) Students have to make a presentation on their internship activities in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the internship final report. However interim or periodic reports and reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations. 7) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12. 8) The broad format of the internship final report shall be as follows <ul style="list-style-type: none"> • Cover Page • Certificate from College • Certificate from Industry / Organization • Acknowledgement • Synopsis • Table of Contents 						

- Chapter 1 - Profile of the Organization – Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
- Chapter 2 - Activities of the Department -
- Chapter 3 – Tasks Performed – summaries the tasks performed during 8 week period
- Chapter 4 – Reflections – Highlight specific technical and soft skills that you acquired during internship
- References & Annexure

Course Outcomes:

After going through the internship the student will be able to:

CO1: Apply engineering and management principles

CO2: Analyze real-time problems and suggest alternate solutions

CO3: Communicate effectively and work in teams

CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of the Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

- | | |
|--|-----|
| (1) Explanation of the application of engineering knowledge in industries | 35% |
| (2) Ability to comprehend the functioning of the organization/ departments | 20% |
| (3) Importance of resource management, environment and sustainability | 25% |
| (4) Presentation Skills and Report | 20% |

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	H	M	-	M	-	-	-	L	-
CO2	-	-	-	H	M	M	-	L	-	-	-
CO3	-	-	-	-	L	-	M	H	H	-	-
CO4	-	-	-	-	L	-	H	-	-	M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	H
CO2	M	-
CO3	-	M
CO4	M	M

GUIDELINES FOR INDUSTRIAL TRAINING

Course Learning Objectives (CLO):

The students shall be able to:

1	Understand the process of applying engineering knowledge to industrial products & processes
2	Explain the importance of skilling, training and resource management
3	Comprehend the importance of team work, communication and sustainable solutions
4	Imbibe values, professional ethics for life long learning

- 1) The duration of industrial training must be for a minimum of 1 week and maximum of 8 weeks on full time basis.
- 2) Industrial Training in which students pays a fee to the organization / industry will not be considered.
- 3) He/she can undergo training in one or more industry /organization.
- 4) The student must submit letters from the industry clearly specifying his / her name and the duration of the training provided by the company with authorized signatures.
- 5) Industrial training must be related to the field of specialization or the M.Tech program in which the student has enrolled.
- 6) Students undergoing industrial training are advised to use ICT tools such as skype to report their progress and submission of periodic progress reports to the faculty members.
- 7) Every student has to write and submit his/her own industrial training report to the designated faculty.
- 8) Students have to make a presentation on their industrial training in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.
- 9) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
- 10) The broad format of the industrial training report shall be as follows
 - Cover Page
 - Certificate from College
 - Training Certificate from Industry / Organization
 - Acknowledgement
 - Executive Summary
 - Table of Contents
 - Chapter 1 - Profile of the Organization –Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices
 - Chapter 2 – Details of the Training Modules
 - Chapter 3 – Reflections – Highlight specific technical and soft skills that you acquired
 - References & Annexure

Course Outcomes:

After going through the industrial training the student will be able to:

CO1:	Understand the process of applying engineering knowledge to solve industrial problems.
CO2:	Develop skills through training relevant to industrial requirement.
CO3:	Communicate effectively and work in teams.
CO4:	Imbibe ethical practices and develop it as life skill.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation on the application of engineering knowledge	25%
(2) Ability to comprehend the importance of skilling and training	25%
(3) Importance of communication, professional ethics, sustainability	20%
(4) Oral Presentation and Report	30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	H	M		M	-	-	-	L	-
CO2	-	-	-	H	M	M	-	L	-	-	-
CO3	-	-	-	-	L	-	M	H	H	-	-
CO4	-	-	-	-	L	-	H	-	-	M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	H	-
CO3	-	M
CO4	M	M

GUIDELINES FOR INDUSTRIAL VISITS

Course Learning Objectives (CLO):

The students shall be able to:

- (1) Understand the role of industries and service organization in meeting the demands of the society.
- (2) Explain the working of different industries and organizations with an engineering perspective
- (3) Comprehend the importance of team work, communication and sustainable solutions.
- (4) Imbibe values, professional ethics for life long learning.

- 1) Student must visit a minimum of THREE organizations/industry. The duration of the visit per organization must be for ONE full day, during which he/she must comprehend the importance of organization structure, function of various departments, application of engineering knowledge, resource management, importance to environment and safety, professional ethics.
- 2) It is mandatory to visit ONE private multi-national company or public sector industry / organization, ONE medium-small enterprise and ONE rural based or NG organization.
- 3) The student must submit letter from the industry clearly specifying his / her name and the date of visit to the industry with authorized signatures.
- 4) Industrial visit must be related to the field of specialization or the M.Tech program in which the student has enrolled.
- 5) Every student has to write and submit his/her own report on each industrial visit and submit the report to the designated faculty advisor for evaluation.
- 6) A photograph outside the industry with the name and logo of the industry in the background along with the students and faculty members could be included in the report.
- 7) Students have to make a presentation on their industrial visit in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.
- 8) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
- 9) The broad format of the industrial visit report shall be as follows
 - Cover Page
 - Certificate from College
 - Acknowledgement
 - Synopsis / Executive Summary
 - Table of Contents
 - Chapter 1 - Profile of the PSU or MNC – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
 - Chapter 2 – Profile of the SME – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
 - Chapter 3 - Profile of the NGO – must include Organizational structure, services, Manpower, Societal Concerns, Professional Practices
 - Chapter 4 – Comparative Analysis of PSU/MNC – SME – NGO
 - References & Annexure (Permission letters from the organizations for the visit & photographs)

Course Outcomes:

After going through this course the student will be able to:

1	Classify the role of different industries and organization in addressing the needs of the society.
2	Explain the process of applying engineering knowledge in industries and organizations.
3	Describe the importance of communication and team work.

4 Recognize the importance of practicing professional ethics and need for life skills.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

- | | |
|--|-----|
| (1) Explanation of the application of engineering knowledge in industries | 25% |
| (2) Ability to comprehend the functioning of the organization/ departments | 30% |
| (3) Importance of resource management, environment and sustainability | 20% |
| (4) Presentation Skills and Report | 25% |

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	H	M	-	M	-	-	-	L	-
CO2	-	-	-	H	M	M	-	L	-	-	-
CO3	-	-	-	-	L	-	M	H	H	-	-
CO4	-	-	-	-	L	-	H	-	-	M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	M
CO2	M	-
CO3	-	M
CO4	M	M

TECHNICAL SEMINAR					
Course Code	:	16MHT36		CIE Marks	: 50
Hrs/Week	:	L:T:P:S	0:0:4:0	SEE Marks	: 50
Credits	:	2		SEE Duration	: 30 min
Course Learning Objectives (CLO):					
The students shall be able to:					
1	Understand the technological developments in their chosen field of interest				
2	Explain the scope of work and challenges in the domain area				
3	Analyze these engineering developments in the context of sustainability and societal concerns				
4	Improve his/her presentation skills and technical report writing skills				
GUIDELINES					
1) The presentation will have to be done by individual students.					
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.					
3) The topic could be an extension or complementary to the project					
4) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.					
5) Each student must submit both hard and soft copies of the presentation.					
Course Outcomes:					
After going through this course the student will be able to:					
CO1:	Identify topics that are relevant to the present context of the world				
CO2:	Perform survey and review relevant information to the field of study				
CO3:	Enhance presentation skills and report writing skills				
CO4:	Develop alternative solutions which are sustainable				
Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide. The evaluation criteria shall be as per the rubrics given below:					
Scheme for Semester End Evaluation (SEE):					
The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.					
Rubrics for Evaluation:					
	1) Topic – Technical Relevance, Sustainability and Societal Concerns				15%
	2) Review of literature				25%
	3) Presentation Skills				35%
	4) Report				25%
Mapping of Course Outcomes (CO) to Program Outcomes (PO)					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	H	M	M	L	H	H	--	---	---	M
CO2	L	M	-	-	-	-	-	-	-	H	-
CO3	-	-	-	-	-	-	L	M	H	-	-
CO4	-	L	M	-	H	H	-	-	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	M	-
CO3	-	M
CO4	H	M

IV SEMESTER

MAJOR PROJECT			
Course Code	:	16MHT41	CIE Marks : 100
Hrs/Week	:	L:T:P:S	SEE Marks : 100
Credits	:	26	SEE Duration : 3 Hours
Course Learning Objectives:			
The students shall be able to			
1	Understand the method of applying engineering knowledge to solve specific problems		
2	Apply engineering and management principles while executing the project		
3	Demonstrate good verbal presentation and technical report writing skills		
4	Identify and solve complex engineering problems using professionally prescribed standards		
GUIDELINES			
<ol style="list-style-type: none"> 1. Major project will have to be done by only one student in his/her area of interest. 2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization. 3. Allocation of the guides preferably in accordance with the expertise of the faculty. 4. The number of projects that a faculty can guide would be limited to three. 5. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department. 6. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee. 7. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor. 			
Course Outcomes:			
After going through this course the students will be able to			
CO1:	Conceptualize, design and implement solutions for specific problems		
CO2:	Communicate the solutions through presentations and technical reports		
CO3:	Apply project and resource managements skills, professional ethics, societal concerns		
CO4:	Synthesize self-learning, sustainable solutions and demonstrate life long learning		
Scheme of Continuous Internal Examination (CIE)			
Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.			
Phase	:	Activity	Weightage
I 5 th week		Synopsis, Preliminary report for the approval of selected topic along with literature survey, objectives and methodology.	20%

II 10 th week	Mid-term progress review shall check the compliance with the objectives and methodology presented in Phase I, review the work performed.	40%
III 15 th week	Oral presentation, demonstration and submission of project report. After this presentation, the student will have one week time to correct / modify his report to address the issues raised by the committee members.	40%

CIE Evaluation shall be done with marks distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing / analysis 25%
- Demonstration & Presentation 20%
- Report writing 20%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Formulation of Project Objectives & Methodology 20%
3. Experiments / Analysis Performed; Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	M	L	M	L	-	-	-	-
CO2	-	-	-	L	-	-	-	M	H	-	-
CO3	-	-	-	-	L	M	M	-	-	H	-
CO4	-	-	-	-	L	M	H	M	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	H
CO2	-	H
CO3	H	H
CO4	H	H

SEMINAR					
Course Code	:	16MHT42		CIE Marks	: 50
Hrs/Week	:	L:T:P:S	0:0:4:0	SEE Marks	: 50
Credits	:	2		SEE Duration	: 30 min
Course Learning Objectives (CLO):					
The students shall be able to:					
1	Understand the technological developments in their chosen field of interest				
2	Explain the scope of work and challenges in the domain area				
3	Analyze these engineering developments in the context of sustainability, societal concerns and project management				
4	Improve his/her verbal presentation and report writing skills				
GUIDELINES					
1) The presentation will have to be done by individual students. 2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research. 3) The topic could be an extension or complementary to the project topic. 4) Topics could be in multidisciplinary areas and strongly address the technical design issues. 5) The student must be able to highlight or relate these technological developments with sustainability and societal relevance. 6) The students must mandatorily address legal, ethical issues as related to the topic of study. 7) The student shall make an attempt to perform financial / cost analysis or apply project management tools as related to his/her topic of study. 8) Each student must submit both hard and soft copies of the presentation.					
Course Outcomes:					
After going through this course the student will be able to:					
CO1:	Identify topics that are relevant in the present context of the world and relate it to sustainability and societal relevance				
CO2:	Perform literature/market/product survey and analyse information to the field of study				
CO3:	Enhance presentation and report writing skills				
CO4:	Develop creative thinking abilities				
Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of TWO senior faculty members. The evaluation criteria shall be as per the rubrics given below:					
Scheme for Semester End Evaluation (SEE):					
The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.					
Rubrics for Evaluation:					
	• Topic – Technical Relevance, Sustainability and Societal Concerns				15%
	• Literature Review				25%
	• Presentation Skills				35%
	• Report				25%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	--	H	M	M	L	H	H	--	--	--	M
CO2	L	M	--	--	--	--	--	--	--	H	--
CO3	--		--	--	--	--	L	M	H	--	--
CO4	--	L	M		H	H	--	--	--	--	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	M
CO2	-	H
CO3	-	H
CO4	H	H