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.

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Department of Civil Engineering

M. Tech. Highway Technology

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	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

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Department of Civil Engineering

M. Tech. Highway Technology

FOURTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Experiential Learning 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 & Witczak M.W. "Principles of Pavement Design"- 2nd 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 Ulitz "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 nad 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. 0. 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

Reference Books:

1	R.M. Koerner "Designing with Geosynthetics"- 4th Edition Prentice Hall, New Jerssey, 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 AATracked, 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 & LiveLoad 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	-	

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	**10Hrs**
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.	
UNIT – II	**09Hrs**
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.	
UNIT – III	**09Hrs**
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.	
UNIT – IV	**10Hrs**
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	
UNIT – V	**10Hrs**
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.	

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

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	M	H	-	-	-	-	L	-	-	-
CO2	H	M	H	-	-	-	-	-	-	H	H
CO3	H	H	H	H	-	-	-	-	-	H	H
CO4	H	M	H	H	-	-	-	-	-	H	H

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

	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.

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
    - 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 cmmittee 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**	**0:0:52:0**	**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

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 10th week	Mid-term progress review shall check the compliance with the objectives and methodology presented in Phase I, review the work performed.	40%
III 15th 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