



Shri Rawatpura Sarkar University, Raipur, Chhattisgarh

Faculty of Engineering

Shri Rawatpura Sarkar University, Raipur



Examination Scheme & Syllabus

for

M.Tech.(Highway Engineering)

Semester-I

**Outcome Based Education (OBE) and Choice Based Credit System
(CBCS)**

(Effective from the Session: 2022-23)



Shri Rawatpura Sarkar University, Raipur, Chhattisgarh

Faculty of Engineering

Two Years M.Tech. Programme

Scheme of Teaching and Examination

M.Tech. First Semester Highway Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2022-2023)

S.No.	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			Sem End Exam Duration (Hrs)
			L	T	P		Continuous Evaluation	Sem End Exam	Total	
1	MENHE101T	Advanced Computational Methodology	3	1	-	4	30	70	100	3
2	MENHE102T	Highway Material and Testing	3	1	-	4	30	70	100	3
3	MENHE102P	Highway Material and Testing	-	-	2	1	15	35	50	-
4	MENHE103T	Transportation Planning	3	1	-	4	30	70	100	3
5	MENHE104T	Highway Geometric Design	3	1	-	4	30	70	100	3
6	MENHE105T	Elective –I	3	1	-	4	30	70	100	3
7	MENHE106P	Traffic Engineering Lab	-	-	2	1	15	35	50	-
Total Contact Hr Per Week: 24			Total Credit: 22			Grand Total Marks:			600	

L: Lecture T: Tutorial P: Practical

Elective-I

S.NO.	Course Title
1	Low Cost Road
2	Highway Equipments & Machinery
3	Cement Concrete Road Construction



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Advanced Computational Methodology				
Course Code	MENHE101T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Engineering Mathematics –I & II				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Represent the problems mathematically. • Optimize the solutions. 				
Course Contents	<p>UNIT – I Graph Theory And Its Application Basic Terminology. Simple graph. Multi graph,. Types of graph .Path .Cycles Eulerian and Hamiltonian graph. Shortest path problem Representation of graph. Trees and their properties. Spanning Tree. Binary Tree. Tree traversal.</p> <p>UNIT - II Fuzzy Set And Its Applications Fuzzy sets-Basic definitions, α-level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products, Algebraic products. Bounded sum and difference, t-norms and t-conorms. The Extension Principle- The Zadeh’s extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.</p> <p>UNIT - III Cryptography And Its Application Introduction to the Concepts of Security: The need for security, Security Approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks. DES, RSA, Digital Signature.</p> <p>UNIT - IV Statistical Analysis Expectation and variance of random variable. Sampling Distribution. Testing a Hypothesis. Level of significance. Confidence limits. Test of significance for large sample. Central limit theorem. Test of significance for means of two large samples. Sampling Variables-small samples. Student t-distribution, Chi-square test.</p>				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<p>UNIT - V</p> <p>Optimization Techniques</p> <p>Dynamic Programming-Deterministic and Probabilistic Dynamic programming. Inventory- Basic characteristics of an inventory system. The Economic order quantity. Deterministic models. Network analysis (PERT/ CPM).</p>
<p>Course Outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none"> • This is the foundation of research and development in the computational domain of engineering and technology. • Analyze the result numerically and linguistically by fuzzy theory. • Emphasize the meaning and purpose of these techniques and their use in solving Engineering Problems. • As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. • This is a transformation from theory to application through measuring theory of natural problems and its applications.
<p>Text Books</p>	<ol style="list-style-type: none"> 1. Calculus of Variations with Applications, Gupta, A.S.-Prentice Hall of India(P) Ltd., New Delhi, 6th print,2006 2. Introduction to Partial Differential Equations, Sankar Rao, .K.- Prentice Hall of India(P) Ltd., New Delhi, 5th print,2004 3. Advanced Engineering Mathematics, Jain R. K Iyengar S.R.K.-Narosa publications 2nd Edition,2006 4. Numerical Methods in Science and Engineering, Grewal, B.S-Kanna Publications, New Delhi. 5. Numerical Methods, S Chandand Co. Ltd, Kandasamy. P, Thilagavathy. Kand Gunavathy, K- New Delhi, 5th Edition,2007 6. Theory and problems of Complex Variables with an Introduction to Conformal Mapping and Its applications, Schaum's outline series, Spiegel, M.R-McGraw Hill BookCo.,1987.
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. Multi - Objective Optimization Using Evolutionary Algorithms, K. Deb (2003) John Wiley 2. Applied Statistics & Probability for Engineers: Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Wiley India. 3. Parallel distributed processing Vol.1 (1986) Rumelhart, D.E and McClelland, J.L., M I T Press, 1986. 4. Fuzzy logic implementation and applications (1996), Patyra, M.J. and Mlynek Wiley



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Highway Material and Testing				
Course Code	MENHE102T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Transportation Engineering-II				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Know the characteristics of various materials used in the pavement of highways. • About various layers of pavement and the materials used in the respective layers. • Design the highway and airport • Have knowledge about the various tests which need to be carried out on soils, aggregate and bitumen for the design of bituminous mixes and pavements. Evaluation tests for pavement strengthening and use of software in highway development 				
Course Contents	<p>UNIT – I</p> <p>Basic road construction material-: types, source, functions, requirements, properties, tests and specifications for use in various components of road. Soil compaction for use in fill and sub grade of roads, compaction studies in laboratory and field, properties of compacted soils.</p> <p>UNIT – II</p> <p>Highway Material : Aggregates, Blending of aggregates by Rothfutch, Triangular Chart, Trial and error and mathematical proportioning methods, Classification nomenclature, quality and manufacture of aggregates with respect to W.B.M. , bituminous and concrete roads.</p> <p>UNIT – III</p> <p>Classification and various terms used related to tar and bitumen, uses and application of different bituminous materials in highway construction, Origin and preparation of different grades of bitumen and tar used for road construction. The Rheology of bituminous binders, Adhesion of binders to road aggregates and mechanism of stripping and adhesion failures, Weathering of bituminous road materials, Admixtures, rubber, tar bitumen and foam asphalt.</p> <p>UNIT – IV</p> <p>Bituminous Mixes: Requirements of bituminous mixes, Methods OF bituminous mix design and their suitability, advantages and disadvantages. Design of bituminous mixes by Marshall, Hubbard Field, Hveem and Tri axial test</p>				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<p>methods.</p> <p>UNIT – V</p> <p>Materials for Low Cost Roads: Stabilized soils, Lime, Fly Ash, Soil-cement and soil bitumen stabilization, soft aggregates, low cement concrete: Proportioning of concrete mixes by absolute volume method, Road note no.4 method, Kennedy’s method, Talbot Richart method and design method for vibrated concrete.</p> <p>Material Testing</p> <ol style="list-style-type: none"> 1 Aggregate Durability Test 2 E.V.T. test for tar and bitumen 3 Modulus of deformation by triaxial test 4 Marshall test for bituminous mix design 5 Hubbard Field Test 6 Hveem Stabilometer and Cohesion meter test 7 Triaxial Test 8 Compaction test on cement mix 9 Unconfined compression strength test on cement 10 Wetting and Drying test on test 11 Freezing and Thawing test on cement 12 C.B.R. test on cement
<p>Course Outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Identify and select based on their characteristics the basic construction materials for road construction. • Design aggregate gradation for construction of pavement layers keeping in mind the density and strength parameters. • Characterize the binder material for bituminous roads and provide an optimum bituminous mix design. • Understand the mixes for various kinds of roads. • Understand conventional & non conventional materials • The students can have thorough knowledge of tests and bituminous mix design which will give the students added confidence when they go actually in the field
<p>Text Books</p>	<ol style="list-style-type: none"> 1. Highway Engineering S.K Khanna, C.E.G. Justo. 2. Highway Material Manual, S.K. Khanna, C.E.G. JUSTO, A. Veeraragavan. 3. Highway Hand Book by FAW, Publication from NUS, Singapore. 4. Highway materials, Krebs and walker- McGraw Hill Book Co. 1971



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<ol style="list-style-type: none">5. Principles, practice and design of Highway Engg Sharma S.K. 20106. Principles and Practices of Highway Engineering, Kadiyali, L.R., 20067. Relevant IRC and MORT&H codes and guidelines
Reference Books	<ol style="list-style-type: none">1. Standard Data Book on Highway Technology issued by the University may be referred in the P.G Examination of VTU.2. MORTH 'Specification for Roads and Bridges Works'- Indian Roads Congress



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Highway Material and Testing				
Course Code	MENHE102P				
Course Credits	L	T	P	TC	
	-	-	2	1	
Prerequisites	Transportation Engineering-I&II				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Conduct various standard tests on aggregate and bitumen. • Understand the properties of bituminous mixes. • Test the Sub-grade soil. • Test on bituminous mix. 				
Course Contents	<p>Material Testing</p> <ol style="list-style-type: none"> 1. Aggregate Impact Test 2. Los Angeles Abrasion Test 3. Polished Stone Value Test 4. Aggregate Crushing Value Test 5. Specific Gravity and Water Absorption Test 6. Shape Tests 7. Soundness Test 8. Stripping Value of Road Aggregates 9. Penetration Test 10. Ductility and Elastic Recovery Tests 11. Softening Point Test 12. C.B.R. Test 13. Specific Gravity Test on Bitumen 14. Viscosity Tests 15. Flash and Fire Point Tests 16. Tests on Bitumen Emulsion and Cutback Bitumen 17. Tests on Polymer and Rubber Modified Bituminous Binders 				
Course Outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Characterize the pavement materials. • Perform quality control tests on pavement material and pavements. 				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<ul style="list-style-type: none">• Ability to characterize the road aggregates.• Acquired the expertise to conduct various tests on binder, modified binders and bituminous mixes.• Gained knowledge on various field tests for the pavement evaluation
Text Books	<ol style="list-style-type: none">1. All tests as per IS, ASTM, AASHTO, TRL, IRC Procedures/specifications and guidelines.2. Highway Material Testing Manual, S.K. Khanna & Justo C.E.G.3. Laboratory Manual in Highway Engineering , A.K. Duggal and Vijay P.Puri
Reference Books	<ol style="list-style-type: none">1. Relevant IS and IRC codes2. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Materials and Pavement Testing`, Nem Chandand Bros,Roorkee3. Gambhir, M. L., `Concrete Manual`, Dhanpat Rai and sons New Delhi



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Transportation Planning				
Course Code	MENHE103T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Transportation Engineering-II				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Study various techniques of transportation system planning in urban and rural areas to avoid various problems occurs in mix traffic. • Study essential concepts of transportation planning • Understand the different modes of transportation and factors affecting planning process for an effective transportation system. • Understand the characteristics of mass transit system and methods of collecting traffic data to propose an effective transport facility. • Understand and sources of zonal trip generation or attraction and then inter-zonal trip distribution methods. • Analyse the mode of transport and its impact on transport system and also the methods of assigning travel trips to various routes for effective management. • Understand the mass transportation options and evaluation of the systems for economic sustainability. 				
Course Contents	<p>UNIT – I Transportation planning methodology, hierarchical levels of planning-statewide, regional, urban, passenger and goods transportation. General concept of transport planning.</p> <p>UNIT – II Urban transportation planning, urban travel characteristics: private and public, travel behavior analysis.</p> <p>UNIT – III Travel demand estimation and forecasting. Trip classification and socio-economic variables in trip making, trip generation: multiple regression analysis, comparative study. Modal split analysis- traditional analysis, behavioral approach to mode choice, two-stage modal split models. Trip distribution: Growth factor method, gravity model, intervening opportunity and competing opportunity models, comparative study. Entropy maximizing method and linear programming method in trip distribution.</p>				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<p>UNIT – IV</p> <p>Traffic assignment- network assignment, capacity restrained and simultaneous, distribution-assignment methods. Direct demand model of transport planning.</p> <p>UNIT – V</p> <p>Land use transport planning: land use transport interactions, transport related land use models, and their use in transportation planning. Corridor type travel planning, statewide and regional transportation planning.</p>
<p>Course Outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Get the knowledge of different modes of transportation and factors affecting the planning process for the different modes? • Propose effective transport facility for the mass transportation after collecting the data required. • Compute the inter-zonal trip generations or attractions and also the trip distributions. • Analyse the impact of transport mode on the transport system to understand effective management along the routes. • Evaluate the economic sustainability of the mass transportation systems.
<p>Text Books</p>	<ol style="list-style-type: none"> 1. Traffic Engineering and Transport planning .Kadiyali L.R. khanna Publishers, New Delhi. 2. Transportation Engineering an Introduction, Jotin chisty, C and Kent Lall B PHI New Delhi. 3. Highway Engineering, Hewes C.I and Oglesby, C.H., Asia Publishing House. 4. Road Development Plan for India-2001-2021, Ministry of Roads Transport and Highways, Indian Roads Congress, New Delhi, 2002. 5. Principles of Urban Transport System Planning, Hutchinson B.G., Mcgraw Hill Book C
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. An Introduction to Transportation Planning, Michael J.Bruton , " Hutchinson,1985 2. Urban Transportation Planning – A Decision Oriented Approach, Michael D. Meyer and Eric J. Miller , McGraw Hill Bookn Company, New York,1984 3. Traffic Planning and Design, F.D. Hobbs, Poargamon Oress 4. Metropolitan Transportation Planning, John W. Dickey,– Tata McGraw Hill Publishing Company Limited, New Delhi, 1980 5. Transportation Engineering – Planning and Design, Paul H.Wright, John Wiley and Sons, New York, 1989.



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Highway Geometric Design				
Course Code	MENHE104T				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Transportation Engineering-I				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Understand the various factors affecting in pavement design • Knowledge on design aspects and methods for rural and urban roads. • Introduce students the principal of highway design, road safety and highway construction materials. • Start applying these skills to design roads and select material for road construction. 				
Course Contents	<p>UNIT-I</p> <p>Design Controls and Criteria: Topography and physical features, traffic, impact of vehicular characteristics on road geometrics, speed and safety.</p> <p>Roadway Capacity Analysis and Design of Lane Requirements: 2 Lane, 4 Lane divided and undivided, Multilane, Freeway, expressways.</p> <p>UNIT-II</p> <p>Cross-section Elements : Pavement surface characteristics, cross slope, lane width ,Curbs, shoulders, drainage channels and side slopes, medians, frontage roads and outer separations.</p> <p>Single lane, 2-lane, 3-lane and multilane highways, freeways and expressways.</p> <p>UNIT-III</p> <p>Sight Distance: Analysis of stopping and passing sight distance, discussions of factors involved, discussion on I.R.C. specification for measurements of sight distance.</p> <p>UNIT –IV</p> <p>Horizontal Alignment: Principles of horizontal curve design, maximum curvature, super elevations rates, transition curves, super-elevation, runoff, attainment of super elevation for undivided and divided highways, distribution of e and f IRC specifications. Pavement widening on curves, sight distance on horizontal curves.</p> <p>Vertical Alignment : Gradients, compensation of grade at curves, design of climbing lanes, shape of vertical curves, procedure for design of summit and valley curves, design of humps. Combination of horizontal and vertical alignment.</p>				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<p>UNIT- V</p> <p>Geometrics of At-grade intersection: Geometric elements, alignment and profile at intersections, median openings, median lanes. Rotary intersection. Geometrics of grade separation and interchanges.</p> <p>Geometrics Design for parking-parking space design for a street and off-set parking, layout of parking garages.</p>
<p>Course Outcomes</p>	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Apply knowledge in fixation of ideal alignment and design of highway • Describe design element: sight distance, horizontal curvature, super elevation, grades, visibility on vertical curves, cross section elements • Use fundamental physics and mathematical knowledge in deriving geometric design equations • Plan surveys, preparation of survey forms and data collection from field for highway design. <p>1. Apply basic principles for the design of roads within the context of a design problem.</p>
<p>Text Books</p>	<ol style="list-style-type: none"> 1. Principles and Practice of Highway Engineering by L.R. Kadiyali and N. B. Lal, Khanna, 7th edition, 2007 2. Traffic Engineering and Transportation Planning by L.R. Kadiyali and N.B.Lal, Khanna Publishers, 2009
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. Highway Engineering by S.K. Khanna, C.E.G. Justo and Veeraraghavan A 10th Ed., Nem Chand & Bros, 2013. 2. Transportation Engineering-An introduction by C. Jotin Khisty and B. Kent Lall, Prentice-Hall, India, 2008 3. IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas. 4. Design codes IRC: SP: 41-1994, IRC SP: 31-1992, IRC 43-1994, Indian Roads Congress, and New Delhi. Highway Capacity Manual 2010, Transportation Research Board 5. AASHTO Design Guide, a Policy on Geometric Design of Highways and Streets, 2001. 6. Fruin, Pedestrian Planning and Design, McGraw Hill Publication, 2003. 7. Institution of Transportation Engineers, Traffic Engineering Hand Book, 4th Edition, Prentice Hall, 1999. 8. Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, PHI Learning.



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Low Cost Road				
Course Code	MENHE105T (Elective-I)				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Transportation Engineering-II				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> Understand the construction method and techniques used in roads, to know about the classification of roads and maintenance of roads. 				
Course Contents	<p>UNIT-I</p> <p>Introduction: Concept, objective, scope and coverage of low cost and rural roads. Significance of low cost roads for developing countries, with special reference to India.</p> <p>Rural Road Planning And Investment: State of art, review of existing practices and their deficiencies in rural roads planning. Socio-economic aspects in planning. Preparation of rural road master plans and their evaluation. Stage constructions and planning, and utilization of successive investments.</p> <p>UNIT – II</p> <p>Geometrics for Low Cost Rural Roads: Traffic and design speed, horizontal alignment, vertical alignment, and cross-section elements.</p> <p>Pavement Design Aspects for Low Cost Rural Roads: Existing pavement design practices for rural roads. Minimum level of serviceability concept for rural roads. Use of strength index as a substitute to CBR (IRC). Thickness design charts (IRC).</p> <p>UNIT-III</p> <p>Materials for Low Cost Roads: Stabilized soils. Design of soil-lime, soil-cement, soil-bitumen and soil-lime-fly ash mixes. Use of soft aggregates in low cost roads.</p> <p>UNIT- IV</p> <p>Construction, Operation and Plants: Surveying and setting, Excavation, hauling, shaping and compaction, stabilized soils –spreading, mixing, and compaction. Appropriate technologies, tools, plants and equipments for construction of low rural roads I.R.C. practices.</p> <p>UNIT- V</p> <p>Road Drainage: Drainage of road surface, pavement layers and cross drainage works. Various low cost drainage alternatives.</p> <p>Maintenance: Short term routine maintenance, long term maintenance. Organization and finance for maintenance works.</p>				
Course	After the completion of course:				



M.Tech. (Highway Engineering)
Semester-I
2022-23

Outcomes	<ul style="list-style-type: none"> • Understand the construction method & techniques used in roads. • Know about the classification of roads & maintenance of roads. • Understand problems during construction in rural roads. • Understand various techniques used technical terms. • Understand the road surface drainage & low cost drainage alternatives.
Text Books	<ol style="list-style-type: none"> 1. Low Cost Roads: Design, Construction and maintenance, L. Odier, Unesco, Butter worths,1971 2. IRC:SP:20-2002,Rural Roads Manual 3. Highway Engineering, Rural Roads and Pavements, G.R. Chatburn, J.Wiley and Sons, Inc. Publication, 2010. 4. Rural Transport in India, K. N. Ramanujam, Mittal Publications, 1993. 5. IRC: SP: 30-1993, Manual on Economic Evaluation of Highways Projects in India,. 6. Rural Roads Manual, Indians Roads Congress, IRC SP20 New Delhi.
Reference Books	<ol style="list-style-type: none"> 1. Highway Engineering, Veeraragavan, S.K Khanna and C.E.G. Justo, Nem Chand & Brothers, 2014. 2. Introduction to Transportation Planning, Bruton, M. J., UCL press, London, UK, 1992. 3. Design Manual for Low Volume Roads Ethiopian Roads Authority, , Parts A-G:http://www.icafrica.org/knowledge-publications/article/design-manual-for-low-volume-roadsparts-a-g-116/ 4. Low-Volume Roads Engineering: Gordon Keller & James Sherar, Best Management Practices – Field Guide, USDA Forest Service/USAID, 2003. 27 5. http://www4.worldbank.org/afr/ssatp/Resources/HTML/LVSR/English/Added-2007/2003-LVREngineering-FieldGuide-USA-by-GKeller.pdf 6. IRC SP 20: Rural road manual, Indian road congress, New Delhi, 2002 6. Yan H. Huang, Pavement Analysis and design, Second Edition, prentice hall inc, 2004



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Highway Equipments and Machinery				
Course Code	MENHE105T (Elective-I)				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Transportation Engineering- I&II				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Understand major equipments used for road construction works along with their working principle. • Distinguish the advantages and limitations of the equipment used for earth excavation and grading. • Evaluate the production capacity of the plants producing aggregates. • Understand the knowledge of pavers and form works used to lay flexible and rigid pavements. • Workout the cost of hiring the equipment and evaluate optimum turnout from the equipment. 				
Course Contents	<p>UNIT-I</p> <p>Selection of highway equipments; Operating cost; depreciation cost, calculation by different methods; economic life of Highway equipment; manual and mechanical method of highway construction ; tractors, uses and types, grad ability; bulldozers , types, operations; Ripping of rock, types of rippers, economy of ripping rocks.</p> <p>UNIT-II</p> <p>Soil compaction , types of compacting equipments & their output; scrapers, types, operation, cycle time, output, load growth curve: power shovels, size of power shovel, basic parts and operation, factors affecting output of power shovel; draglines basic parts and operation, factors affecting its output.</p> <p>UNIT-III</p> <p>Trucks and Wagons. General features, types, machine of size of truck and power shovel; Belt Conveyor, its economy, idlers, power required to drive, driving equipment, hold backs, feeders, trippers; Crushers, jaw crusher, Roll crusher Road and Ball Mill, selection of crushing equipment, screening aggregate, handling crushed stone aggregate.</p> <p>UNIT-IV</p> <p>Cement concrete mixers, proportioning of concrete mixtures, fresh concrete, batching of concrete materials. Tilting concrete mixer, concrete batching plant, Transit mixer, ready mixed concrete , placing of concrete; vibrators, types, cold water & hot water curing of concrete, slip form pavers.</p>				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<p>UNIT-V</p> <p>Drilling rock and earth, types of drilling machines, selection of drilling method and machine, selecting drilling pattern, rate of drilling rock; Blasting of rock, dynamite, ammonium nitrate explosives, slurries, stemming, firing charges, safety fuse, electric blasting cap, delay blasting caps handling misfire, presplitting rock, spacing of blast holes.</p>
Course Outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none">• Get the knowledge of major equipment used for road construction works along with their working principle.• Distinguish the earth excavation and grading equipment based on their advantages and limitations for use in road construction.• Work out the production capacity of the mixing plants for flexible and rigid pavements producing different sizes of aggregates.• Understand the use of pavers and form works to lay flexible and rigid pavements and the precautions to be taken while using them.• Estimate and find the cost of hiring equipment for construction activity.
Text Books	<ol style="list-style-type: none">1. Construction Planning Equipment and Methods, Peurifoy/ schexnayder, Mcgraw- Hill Higher Education.2. Construction Equipment and its Management, Sharma S. C. - Khanna Publishers, Delhi.3. Operation Manuals of various equipment manufactures.
Reference Books	<ol style="list-style-type: none">1. Construction Equipment and its Management”- Sharma S.C. Khanna Publishers, Delhi2. Construction Project Management,-Planning, Scheduling and Controlling K.K. Chitkara,”- Tata McGraw –Hill Publications.



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Cement Concrete Road Construction				
Course Code	MENHE105T (Elective-I)				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Transportation Engineering-I				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Learn about characteristic of cement used in road construction. • Design the base course thickness and selection of materials as base layer for CC pavements. • Characteristics of different types of bituminous layers and design of bituminous surfacing along with safety aspects needed for roads. 				
Course Contents	<p>UNIT-I Cement Concrete Pavements: Construction methods, paving quality control pavements, quality control tests equipments, working principle, capacity, and rate of production, advantages and limitations of various types of construction equipment.</p> <p>UNIT-II Joint Details: type, bars, Design of joint filler and sealer, slab thickness as per IRC guidelines, Design features of continuously reinforced concrete pavements, problems</p> <p>UNIT-III Reinforced Cement Concrete Pavements: Continuously reinforced concrete pavement, pre-stressed concrete pavements, necessity of reinforcement in pavements.</p> <p>UNIT-IV Fiber Reinforced Concrete Pavements: Advantages, applications mix construction procedure.</p> <p>UNIT-V Construction Planning & Management: CPM/PERT in cement concrete road construction, project management framework, scope, project objectives, project environment, causes of project failure, project development process.</p>				
Course Outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Design bituminous surfacing and other layers along with safety aspects needed during construction. • Design the base course thickness and select materials for base layer in CC pavements. 				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<ul style="list-style-type: none">• Analyse the defects in road construction and general pavement failures and propose suitable remedies.• Understand about construction of cement concrete pavement, plants and required for its construction.• Analyse the defects in road construction and general pavement failures with remedies.
Text Books	<ol style="list-style-type: none">1. Concrete Roads, Sparkes, F. N. and Smith A.F., Edwards Amola & Co., London2. MORTH Specification for Road and Bridges works, IRC Publication.
Reference Books	<ol style="list-style-type: none">1. Hand Book on Cement Concrete Roads”- Cement Manufacturers Association, New Delhi2. MoRTH “Specifications for Roads and Bridge Works”- 2001, fourth revision, Indian Roads Congress3. MoRTH “Manual for Construction and Supervision of Bituminous Works”- 2001, Indian Roads Congress4. MoRTH “Manual for Maintenance of Roads”- 1989, Indian Roads Congress5. IRC: 42-1994, IRC:15-2002, IRC SP :11-1988, , 55-2001, 57-2001,58-2001, IRC 19-1977, 27-1967, 29-1988, 34- 1970, 36-1970,48-1972,61-1976, 63-1976, 68-1976, 81-1997,82-1982, 84-1983,93-1985, 94-1986, 95-1987, 98-1997, 105-1988.



M.Tech. (Highway Engineering)
Semester-I
2022-23

Course Title	Traffic Engineering Lab				
Course Code	MENHE106P				
Course Credits	L	T	P	TC	
	-	-	2	1	
Prerequisites	Transportation Engineering-I & II				
Course Objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> • Impart knowledge about the traffic volume study, accident and parking studies and road safety audit. • Provides clear understanding on conducting various types of traffic surveys data collection, analysis, inference and presentation 				
Course Contents	<p>Traffic Engineering & Field Studies.</p> <ol style="list-style-type: none"> 1. Traffic volume study using videography technique. 2. Traffic volume study by Mechanical counters 3. Traffic speed study using videography technique. 4. Parking Study 5. Accident Investigation study 6. Study for Improvement of an Accident Prone location 7. Determination of Reaction time of Driver 8. Speed study by endoscope 9. Design of traffic rotaries and Intersection 				
Course Outcomes	<p>After the completion of course:</p> <ul style="list-style-type: none"> • Understand analyze the traffic volume • Understand analyze and design the parking area • The students would have an understanding on conducting various types of traffic surveys involving data collection its analysis and the inference and way of presentation. 				
Text Books	<ol style="list-style-type: none"> 1. Traffic Engineering – Theory & practice, Pignataro L.J. ,John Wiley publishing house 2. Relevant IS and IRC codes 3. Traffic Engineering and Transport Planning, Kadiyali L.R. Khanna Publishers 				
Reference Books	<ol style="list-style-type: none"> 1. Traffic Engineering - Theory &Practice - Louis J. Pignataro, Prentice Hall Publication. 				



M.Tech. (Highway Engineering)
Semester-I
2022-23

	<ol style="list-style-type: none">2. Principles of Highways Engineering and Traffic Analysis - Fred Mannering & Walter P. Kilaeski, John Wiley & Sons Publication.3. Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, PHI Learning.
--	---