SHRI VENKATESHWARA UNIVERSITY

Syllabus

M.TECH (Highway Engineering)

(Two Years Post Graduation Programme)

(w.e.f. 2019-20)

SCHOOL OF ENGINEERING & TECHNOLOGY

Evaluation for M.Tech (Highway Engineering)

SEMESTER-I													
Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	MHE-101	Urban Transportation Planning	3	0	0	20	10	30		70		100	3
2	MHE-102	Pavement Analysis and Design	3	0	0	20	10	30		70		100	3
3	MHE-011	Advanced Pavement Materials	3	0	0	20	10	30		70		100	3
4	MHE-022	Traffic Control and Management	3	0	0	20	10	30		70		100	3
5	MHE-111	Traffic Measurements Lab	0	0	4				25		25	50	2
6	MHE-112	Computational Lab	0	0	4				25		25	50	2
7	MLC-101	Research Methodology and IPR	2	0	0	20	10	30		70		100	2
8	AUD-101	English for Research Paper Writing	2	0	0								0
		Total										600	18

DETAILED SYLLABUS

M.Tech. (Highway Engineering) I Semester

MHE-101: URBAN TRANSPORTATION PLANNING

Course Type: Core; Instruction: L-T-P-C: 3-0-0-3 Course Outcomes: *At the end of the course, students will be able to*

CO1	Distinguish various Urban Forms and Structures and Identify urban transportation problems
CO2	Estimate urban travel demand.
CO3	Plan urban transport networks.
CO4	Develop land use transportation models
CO5	Identify urban transport corridors and Prepare urban transportation plans.

Detailed Syllabus:

Urban Forms and Structures:

Urbanisation and Migration, Findings of Commission on Urbanisation, Urban forms: Garden City, Linear city, Radburn, Urban Neighborhood, Precinct, MARS, Le Corbusier, Collin Buchanan, etc. Urban structures: Centripetal type, Grid type, linear type and directional grid type, Evolution of spatial structure.

Urban Transportation Problems and Policy:

Urban transportation Issues, Travel Characteristics, Evolution of Planning Process, Supply and Demand – Systems approach; NUTP, Recommendations of 12th FYP and NTDP

Travel demand:

Trends, Overall Planning process, Long term Vs Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques.

Data collection and inventories:

Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

Trip Generation and Distribution:

UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates; Trip Distribution: Growth Factor Methods, Gravity Models, Opportunity Models, Time Function Iteration Models.

Mode Split and Traffic Assignment:

Mode Choice Behaviour, Competing Modes, Mode Split Curves, Models and Probabilistic Approaches; Traffic Assignment: Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment, Diversion Curves.

Land Use – Transportation Models:

Concentric urban land use model, Sector land use model, multiple nuclei land use model, hybrid land use models, Cellular automata models, and land rent theory; Urban regions. Land use – Transportation Interactions; Classification of LUT Models, Economic Base Mechanism, Allocation Mechanism and Spatial Allocation and Employment Relationships, Garin Lowry Models.

Corridor Identification - Plan preparation and evaluation:

Master plans, Selection of Corridor, Corridor Identification, Corridor deficiency Analysis; TOD; Travel Forecasts to Evaluate Alternative Improvements, Impacts of New Development on Transportation Facilities; Pivot Point Analysis, Environmental and Energy Analysis.

READING:

1. Bruton, M. J., An Introduction to Transportation Planning (The Living Environment), UCL Press, London, UK, 2000.
2. C. Jotin Khisty and B. Kent Lall, Transportation Engineering: An Introduction, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003.
3. C.S. Papacostas and Panos D. Prevedouros, Transportation Engineering and Planning, Prentice Hall of India Pvt. Ltd., 2001.

4. Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw Hill, 1974.
5. Institute of Transportation Engineers (Michael D. Meyer Editor), Transportation Planning Handbook, Fourth Edition, John Wiley & Sons, Inc., New Jersey, 2016.
6. Juan de Dios Ortuzar and Luis G. Willumsen, *Modelling Transport, 4th Edition*, John Wiley and Sons, New York 2011.
7. Michael D. Meyer and Eric J. Miller, Urban Transportation Planning: A decision oriented Approach, Second Edition, McGraw Hill, 2001.

MHE-102: PAVEMENT ANALYSIS AND DESIGN
Course Type: Core; Instruction: L-T-P-C: 3-0-0-3

Course Outcomes: *At the end of the course, students will be able to*

CO1	Analyze the stresses and strains in a flexible pavement using multi-layered elastic theory, and the KENLAYER program.
CO2	Analyze stresses and strains in a rigid pavement using Westergaard's theory, and the KENSLABS program.
CO3	Design a flexible pavement using IRC, Asphalt Institute, and AASHTO methods.
CO4	Design a rigid pavement using IRC and AASHTO methods.

Detailed Syllabus:

1. **Pavement Types and Materials:**

Types and component parts of pavements; highway and airport pavements. Basic characteristics of materials used in pavements.

2. **Stresses in Flexible Pavements**: Layered system concepts.

Stress solution for one, two and three layered systems. Fundamental design concepts.
Stress analysis in flexible pavements using KENLAYER.

3. **Stresses in Rigid Pavements:**

Westergaard's theory and assumptions.
Stresses due to curling, stresses and deflections due to loading, frictional stresses. Stresses in dowel bars and tie bars.
Stress analysis in rigid pavements using KENSLABS.

4. **Factors Affecting Pavement Design:**

Variables considered in pavement design.
Classification of axle types, standard and legal axle loads, tyre pressure, contact pressure, ESWL, EWLF and EAL concepts.
Traffic analysis: ADT, AADT, truck factor, growth factor, lane distribution factor, directional distribution factor and vehicle damage factor.

5. **Design of Flexible Pavements:**

IRC method of flexible pavement design.
Asphalt Institute's methods with HMA and other base combinations. AASHTO method of flexible pavement design.
Design of flexible pavement shoulders.

6. **Design of Rigid Pavements**:

IRC method of plain jointed and continuously reinforced rigid pavement design. AASHTO method of rigid pavement design.
Design of rigid pavement shoulders.

7. **Design of Pavement Drainage**

Detrimental effects of water, methods for controlling water in pavements. Drainage materials: aggregates, geotextiles, pipes.
Estimation of inflow, determination of drainage capacity.

READING:

1) **Asphalt Institute.** *Thickness Design – Asphalt Pavements for Highways and Streets Manual Series No. 1 (MS-1)*, Asphalt Institute, Kentucky, USA, 1999.
2) **Das, A.** *Analysis of Pavement Structures*, CRC Press, Taylor and Francis Group, Florida, USA, 2015.
3) **Huang, Y.H.** *Pavement Analysis and Design*, Second Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi, India, 2008.
4) **IRC: 37-2012** *Guidelines for the Design of Flexible Pavements*, The Indian Roads Congress, New Delhi, India, 2012.
5) **IRC:58-2015** *Guidelines for the Design of Plain Jointed Rigid Pavements for Highways*, The Indian Roads Congress, New Delhi, India, 2015.
6) **Mallick, R.B.** and **T. El-Korchi** *Pavement Engineering – Principles and Practice*, CRC Press, Taylor and Francis Group, Florida, USA, 2009.
7) **MEPDG-1.** *Mechanistic-Empirical Pavement Design Guide - A Manual of Practice*, Interim Edition, American Association of State Highway and Transportation Officials, Washington, D.C., USA, 2008.
8) **Papagiannakis, A.T.** and **E.A. Masad** *Pavement Design and Materials*, John Wiley and Sons, New Jersey, USA, 2008.

Yoder, E.J. and **M.W. Witczak** *Principles of Pavement Design*, Second Edition, John Wiley and Sons, New York, USA, 1975.

MHE-111: TRAFFIC MEASUREMENTS LABORATORY
Course Type: Core; Instruction: L-T-P-C: 0-0-4-2

Course Outcomes: *At the end of the course, students will be able to*

CO1	Conduct traffic studies for estimating traffic flow characteristics.
CO2	Determine the capacity and level of service of a highway element.
CO3	Estimate parking requirements and inventory analysis.
CO4	Design traffic signal systems.
CO5	Determine causative analysis of delays.

Detailed Syllabus:

Volume studies:
Direction, Duration and Classification of Traffic Volume at Mid-Block Section and Intersections, Manual, and Mechanical Methods, Headway Distributions

Speed studies:
Spot Speed Studies - Radar Speed Meters

Journey time and delay studies:
Travel Time and Delay Studies by Floating Car Method

Gap acceptance studies:
Study of Gaps, Lags, Critical Gaps at Intersections

Intersection delay studies:
Delay Measurement at Uncontrolled Intersections and Signalised Intersections

Parking surveys:
Parking Inventory and Turnover Studies

Measurement of driver characteristics:
Reaction Testing, Action Judgement Testing, Driver Vision Testing, Discriminative Reaction Testing, Evaluation of driver Knowledge – Traffic Rules – Road Signs & Markings – Traffic Signs and Motor Vehicle Act Relevant clauses

Highway Capacity Estimation:
Videographic method, Dynamic PCU

READING:

1. C. Jotin Khisty and, B. Kent Lall, Transportation Engineering: An Introduction, Prentice Hall; 3rd Edition, 2002.
2. Currin, Introduction to Traffic Engineering: Manual F/data Collect & Analysis, CL Engineering, 2nd Edition, 2012.
3. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2011.
4. Pignataro LJ. Traffic Engineering: Theory and Practice; Prentice hall, Inc, 1973
5. Roger P. Roess, Elena S. Prassas and William R. McShane, Traffic Engineering, Prentice Hall, 4th Edition, 2010.

MHE-112: COMPUTATIONAL LABORATORY
Course Type: Core; Instruction: L-T-P-C: 0-0-4-2

Pre Requisite Courses: Nil

Course Outcomes: *At the end of the course, students will be able to*

CO1	Understand the data types, sampling and choice of method to evaluate.
CO2	Perform data analysis and interpretation using programming tools and packages.
CO3	Perform statistical significance tests and derive conclusions from the results.
CO4	Construct statistical relationships and carryout validation from actual data.

Mapping of the Course Outcomes with Program Outcomes:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2			1					1
CO2	3	2		1	1	1				1
CO3	3	2		2	1	1				1
CO4	2	3	3	2	1	1	1		1	1

Note: 1: Slightly 2: Moderately 3: Substantially

Detailed Syllabus:
Data presentation
Exercise for measuring central tendency, dispersion and shape of data, graphical representation, plots and pattern, interpretation of results, and histograms by using MS office tools and other statistical packages.

Data sampling and description
Sampling exercises, data storing, handling, cleaning, and descriptive analysis exercises by using MS assess, excel and statistical tools.

Data Analysis and statistical inference
Exercise for fitting probabilistic distributions, correlation analysis, simple linear and multiple linear regressions, nonlinear regression, parametric and non-parametric tests, test of significance, paired and unpaired sample tests and evaluation, analysis of variance, univariate and multivariate analysis, time series analysis, data analysis with MS excel and statistical package.

Basics of Programming for data analysis:
R programming for statistical analysis and probability studies, applications of C++ /Java, Codeskulptor, python etc.

READING:

1. Bovas A., N. Nair U., *Quality Improvement through Statistical Method*, Springer Science & Business Media, 01-Aug-1998.
2. Clifford S., E. S. Park, Laurence R. R., *Transportation Statistics and Microsimulation*, CRC Press, Taylor and Francis group, 2011.

3. Dewhurst, Stephen C., *C++ Common Knowledge: Essential Intermediate Programming*, Addison-Wesley, 2005.
4. John C., *Software for Data Analysis: Programming with R*, Stanford University, Springer, 2008.
John G., *Introduction to Computation and Programming Using Python*, MIT, Press book, 2013.

MHE-011: ADVANCED PAVEMENT MATERIALS
Course Type: Elective; Instruction: L-T-P-C: 3-0-0-3

Course Outcomes: *At the end of the course, students will be able to*

CO1	Determine the proportions of ingredients required for the mix design of both asphalt mixtures and cement concrete.
CO2	Characterize the pavement materials including soil, aggregate, asphalt, cement, asphalt mixtures, cement concrete.
CO3	Select appropriate asphalt binder for construction of a flexible pavement depending upon the traffic and climatic conditions.
CO4	Choose appropriate stabilization technique for pavement applications.

Detailed Syllabus:

1 **General**:
Materials used in pavement construction. Conventional and nonconventional materials.

2 Aggregate:
Physical and mechanical properties of aggregates. Blending of aggregate.
Alternate materials for conventional aggregates including natural, manufactured, industrial by-products, and waste materials.

3 Bituminous Binders:
Types of bituminous binders including unmodified bitumen, modified bitumen (crumb rubber modified bitumen, polymer modified bitumen), bitumen emulsion, and cutback bitumen.

Tests on bitumen, physical properties, specifications for paving bitumen. Rheology of bituminous binders: Newtonian and non-Newtonian fluids. Grading of bitumen: penetration, viscosity, and performance grading.
Introduction to linear viscoelasticity: creep and recovery; stress relaxation; mechanical models to describe viscoelastic response including Maxwell element, Voigt-Kelvin element, standard linear solid element, Burger's element.
Dynamic response to sinusoidal loading of viscoelastic materials, energy storage and dissipation. Time-temperature superposition, construction of master curves.
Check for linear scaling and superposition of separate responses.

4 Bituminous Mixes:
Design of bituminous mixes using Marshall method, and SUPERPAVE method. Types of bituminous mixes including hot mixes, cold mixes, warm mixes and applications.
Permanent deformation, dynamic modulus, fatigue of bituminous mixes, moisture induced damage in bituminous mixes.

1 Cement and Cement Concrete:
Cement: chemical composition, types, physical properties, admixtures. Physical properties of cement concrete related to pavement applications. Design of cement concrete mixes for pavements.
Special types of cement concrete: polymer concrete composites, sulphur concrete composites, fibre reinforced concrete, ferrocement, roller compacted concrete, and high strength concrete.

5. Granular Materials:
Basic soil properties relevant to pavement applications.
Resilient modulus of granular materials, modulus of subgrade reaction.

7 **Stabilization:**
Soil stabilization: use of lime, cement, bitumen, and other commercial stabilizers. Applications of geosynthetics in pavements.

READING:

1. **Asphalt Institute.** *Asphalt Mix Design Methods*, *Manual Series No. 2 (MS-2)*, Seventh Edition, Asphalt Institute, Kentucky, USA, 2014.
2. **Huang, Y.H.** *Pavement Analysis and Design*, Pearson Prentice Hall, New Jersey, USA, 2004.
3. **IRC: 44-2008** *Guidelines for Cement Concrete Mix Design for Pavements*, the Indian Roads Congress, New Delhi, India, 2008.
4. **Kandhal, P.S.** *Bituminous Road Construction in India*, PHI Learning Pvt. Ltd., New Delhi, India, 2016.
5. **Mallick, R.B.** and **T. El-Korchi** *Pavement Engineering – Principles and Practice*, CRC Press, Taylor and Francis Group, Florida, USA, 2009.
6. **Ministry of Road Transport and Highways.** *Specifications for Road and Bridge Works*, Fifth Edition, Indian Roads Congress, New Delhi, India, 2013.
7. **Papagiannakis, A.T.** and **E.A. Masad** *Pavement Design and Materials*, John Wiley and Sons, New Jersey, USA, 2008.
8. **Richard M. Christensen,** *Theory of Viscoelasticity, Second Edition*, Dover Publications, Inc, New York, USA, 1982.
9. **Sherwood, P.T.** *Alternative materials in road construction*, Thomas Telford, New York, USA, 1997.

MHE-022: TRAFFIC CONTROL AND MANAGEMENT

Course Type: Elective; Instruction: L-T-P-C: 3-0-0-3

Course Outcomes: *At the end of the course, students will be able to*

CO1	Understand the traffic regulations and control policies.
CO2	Design and suggest speed control measures for all types of roads.
CO3	Design traffic control systems for urban and rural roads.
CO4	Develop traffic management strategies at local level road network.

Detailed Syllabus:

Traffic control and regulations:

Traffic control and its necessity, types, emerging technologies, benefits, strategies, legislation related to traffic control, highway and urban road traffic acts, traffic control warrants, traffic control aids, road signs and signals for traffic control, placement of signs.

Speed control measures:

Free speed and speed limits, road works speed limit, highway speed control, speed control in residential areas, counter measures; speed humps, speed cushions, speed tables, raised intersection, center Island, surface treatments and markings, in-roadway warning lights, community awareness and education, speed enforcement, signs for speed control, case studies.

Urban and interurban traffic control:

Control variables, mid block and intersection traffic controls studies, arterial roads and network controls, traffic at isolated intersections and control, signals and controllers, basic signal design, bicycle and pedestrian considerations, vulnerable and disable road users work zone and school zone traffic control, control systems, special controls, measure of effectiveness, public transport priorities, signal coordination, interurban highways, high speed corridors, design of rural highways and control systems, high speed expressways, access control, design example and case studies.

Traffic management and strategies

Traffic management concepts, traffic monitoring, incident detecting and advising road users, traffic system and management centers, communication and information systems, methods of information disseminations, traffic segregation, diversions and one-way street, traffic operational management, exclusive lanes, integrated traffic management, ITS strategies for advanced traffic management, design examples.

Area Traffic Control:

Local level traffic planning and management, residential neighbourhood, street lighting equipment, maintenance and installation issues land use developments and traffic system, computer applications and traffic simulation, case studies.

READING:

1. Hamada Alshaer *Demanding Traffic Control and Management in Next Generation Networks*, Lap Lambert

academic publishing, 2010
2. Institute of Transportation Engineers, Anurag Pande and Brian Wolshon, Traffic Engineering Handbook, Seventh Edition, John Wiley & Sons, New Jersey, 2016.
3. John E. Tyworth and Joseph L. Cavinato, Traffic Management: Planning, Operations and Control, Addison-Wesley Pub. Co., 1987
4. Laurence Olivo, Traffic Management, Emond Montgomery Publications, 2007
5. Michael Welzl, *Network Congestion Control: Managing Internet Traffic* Publisher: John Wiley & Sons, 2005
6. Myer Kutz, Editor, Handbook of Transportation Engineering Volume I & II, 2nd Edition, McGraw- Hill Professional, 2011

AUDIT 1 : ENGLISH FOR RESEARCH PAPER WRITING AUD -101

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

SYLLABUS CONTENTS

- Planning and Preparation, Word Order, Breaking up long sentences, Structuring
- Paragraphsand Sentences, Being Conciseand Removing Redundancy, Avoiding Ambiguity and Vagueness.
- Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising,
- Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.
- Review of the Literature, Methods, Results,Discussion, Conclusions.
- The Final Check. key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.
- Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Research Methodology and IPR MLC 101 3 0 0

Course Outcomes:
At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Unit 1: INTRODUCTION Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations
Unit 2: Effective literature studies approaches, analysis Plagiarism, and Research ethics
Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee
UNIT 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- Mayall, "Industrial Design", McGraw Hill, 1992.
- Niebel, "Product Design", McGraw Hill, 1974.
- Asimov, "Introduction to Design", Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand,