R22

M.Tech. (HIGHWAY ENGINEERING)

M.Tech. R22 CBCS Curriculum

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous, ISO 9001:2015 & QS I-Gauge Diamond Rated Institute, Accredited by NAAC with 'A++' Grade
NBA Accreditation for B.Tech. CE, EEE, ME, ECE, CSE, EIE, IT Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH, NIRF 113 Rank in Engineering Category
Recognized as "College with Potential for Excellence" by UGC
Vignana Jyothi Nagar, Pragathi Nagar, Nizampet (S.O), Hyderabad – 500 090, TS, India.
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DEPARTMENT OF

CIVIL ENGINEERING

VISION OF THE DEPARTMENT

To develop Civil Engineering Department as a Centre of excellence for imparting value based education to the students at undergraduate and post-graduate level to meet industry needs and to develop as a major research center meeting national and international standards.

MISSION OF THE DEPARTMENT

- To impart in-depth and up-to-date knowledge of Civil Engineering concepts with focus on character enhancement, leadership qualities, effective communication, social responsibility and pursuit of lifelong learning and professional development.

- To provide a platform to the students to engage in original innovative research.

M.TECH.
(HIGHWAY ENGINEERING)

M.TECH. (HWE)

PROGRAM EDUCATIONAL OBJECTIVES

PEO-I: To provide the student with a solid foundation in Planning, Design, Construction, Operation and Maintenance of highway projects in the context of environmental, economic and social requirements.

PEO-II: To equip students with modern concepts and tools which would enable them to become globally competent professionals and fitting into a broad range of career opportunities in highway research and industry.

PEO-III: To prepare the students in lifelong learning for professional advancement, that would help them to execute complex transportation projects with professional ethics and social responsibilities.

M.TECH. (HWE)

PROGRAM OUTCOMES

PO-1: An ability to independently carryout research/investigation and development work to solve practical problems.

PO-2: An ability to write and present a substantial technical report/document.

PO-3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO-4: To motivate the graduate students to address the societal needs by interdisciplinary approach through advanced courses.

PO-5: To enrich the graduate students to get hands on training on latest equipment / software to be industry ready / pursue advanced research.

PO-6: To inculcate ethical practices and to establish understanding of professionalism, safety, sustainability, their duties, and contribution to the society.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(HIGHWAY ENGINEERING)

I SEMESTER **R22**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-I	22PC1HW01	Pavement Material Characterization	3	0	0	3
Professional Core-II	22PC1HW02	Traffic Engineering	3	0	0	3
Professional Core-III	22PC1HW03	Highway Geometric Design	3	0	0	3
Professional Elective-I	22PE1HW01	Urban Transportation Planning	3	0	0	3
	22PE1HW02	Bridge Engineering				
	22PE1HW03	Intelligent Transportation Systems				
	22PE1HW04	Transportation Data Analysis				
	22PE1GT01	Soil Structure Interaction				
Professional Elective-II	22PE1HW05	Remote Sensing and GIS Applications in Highways	3	0	0	3
	22PE1HW06	Road Safety and Traffic Management				
	22PE1HW07	Environmental Impact Assessment for Highway Projects				
	22PE1HW08	Mass Transportation System and Planning				
	22PC1GT03	Ground Improvement Techniques				
Professional Core Lab-I	22PC2HW01	Pavement Engineering Laboratory	0	0	2	1
Professional Core Lab-II	22PC2HW02	Traffic Engineering Field Laboratory	0	0	2	1
Communication Skills	22SD5HS01	Communication Skills for Academic and Research Writing	0	0	2	1
Project	22PW4HW01	Technical Seminar	0	0	4	2
Mandatory	22MN6HS01	Research Methodology and IPR	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(HIGHWAY ENGINEERING)

II SEMESTER **R22**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-IV	22PC1HW04	Pavement Analysis and Design	3	0	0	3
Professional Core-V	22PC1HW05	Highway Project Formulation and Economics	3	0	0	3
Professional Core-VI	22PC1HW06	Advanced Traffic Analysis	3	0	0	3
Professional Elective-III	22PE1HW09	Highway Construction Practices	3	0	0	3
	22PE1HW10	Computational Techniques in Highway Engineering				
	22PE1HW11	Numerical Methods and Applied Statistics				
	22PE1HW12	Advanced Highway Materials				
	22PE1HW13	Highway Projects				
Professional Elective-IV	22PE1HW14	Pavement Management Systems	3	0	0	3
	22PE1HW15	Highway Network Analysis and Optimization Techniques				
	22PE1HW16	Pavement Evaluation and Rehabilitation				
	22PE1HW17	Sustainable Transportation				
	22PE1HW18	Road Asset Management				
Professional Core Lab-III	22PC2HW03	Highway Material Characterization and Traffic Simulation Laboratory	0	0	2	1
Professional Core Lab-IV	22PC2HW04	Highway Numerical Analysis Laboratory	0	0	2	1
Industry Engagement	22SD5HW01	Industry Engagement	0	0	2	1
Project	22PW4HW02	Mini-Project	0	0	4	2
Mandatory	22MN6H02	Ancient Wisdom	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. II YEAR COURSE STRUCTURE AND SYLLABUS

(HIGHWAY ENGINEERING)

III SEMESTER **R22**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Elective-V	22PE1HW19	Rural Road Engineering	3	0	0	3
	22PE1HW20	Artificial Intelligence Applications in Transportation Engineering				
	22PE1HW21	Advanced Travel Demand Modelling				
	22PE1HW22	Traffic Flow Modelling and Simulation				
	22PE1HW23	Big Data Analytics in Transportation				
Open Elective	22OE1CN01	Business Analytics	3	0	0	3
	22OE1AM01	Industrial Safety				
	22OE1AM02	Operations Research				
	22OE1AM03	Entrepreneurship and Start-ups				
	22OE1PS01	Waste to Energy				
Project	22PW4HW03	Project Part – I	0	0	16	8
Total			**6**	**0**	**16**	**14**

IV SEMESTER **R22**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Project	22PW4HW04	Project Part - II	0	0	28	14
Total			**0**	**0**	**28**	**14**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PC1HW01) PAVEMENT MATERIAL CHARACTERIZATION

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand the behaviour on sub-grade soil, aggregates
- To learn about various techniques for improving the ground
- to identify the binder and mix characteristics and the methods for modifications for efficacy in properties.
- To gain knowledge on quality of cements its IRC methods for concrete mix design and role of Admixtures.

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Explain properties and tests performed on sub grade soil, aggregate, bitumen and cement
CO-2: Understand soil stabilization techniques adopted for road constructions
CO-3: Comprehend how to improve bitumen properties by modification techniques
CO-4: Appreciate the advanced concrete technologies used in road construction, role of admixtures and design of concrete mixes

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	2	-	1	-
CO-2	2	1	-	2	-	1
CO-3	1	-	3	3	2	2
CO-4	2	2	3	-	-	2

UNIT-I:
Sub-Grade Soil Characterization: Soil Classification; Index and other basic properties of soil; Types of soils used for construction of different layers of pavement, embankments and their suitability-requirements, Mechanical response of soil- different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. SPT, DCPT, CBR, Plate Load test & resilient modulus test.

UNIT-II:
Introduction to Soil Stabilization: Physical and Chemical modification - Stabilization with admixtures- cement, lime, calcium chloride, Fly ash and bitumen. Grouting; Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control - Geo textiles and synthetics applications in highway constructions.

UNIT-III:

Road Construction Aggregate: Origin, Classification, different sizes of aggregates-suitability of aggregates in pavements layers - different tests on aggregates-limiting values as per MORTH for different layers, Methods of Proportioning and Blending of aggregates, Fuller and Thompson's Equation, 0.45 power maximum density graph; Introduction to Super pave gradation.

UNIT-IV:

Bituminous Road Binders & Mixes: Elastic modulus, visco-elastic and fatigue properties, creep, ageing, Introduction to emulsified bitumen; Foamed bitumen; bituminous mix design using Marshall method with conventional and modified binders. nanotechnology in the bituminous mixes, RAP mixes. Introduction to special mixes such as SMA (IRC: SP:79-2008) and Open Graded Friction Course (IRC:129-2019) Introduction to Super-pave and Balanced mix design. Performance studies

UNIT-V:

Cement Concrete Mix Characterization: Introduction to advanced concretes like self-compacted concrete; light weight concrete; roller compacted concrete for pavement application; Role of different admixtures in cement concrete performance; Joint filers for jointed plain cement concrete pavements; Nano technology applications in cement concrete.

TEXT BOOKS:

1. Highway Materials, Soils and Concretes, Atkins, N. Harold, 4th Edition, Prentice-Hall
2. Asphalt Institute. Mix Design Methods – For Asphalt Concrete and Other Hot-Mix Types Manual Series No. 2 (MS-2), Asphalt Institute
3. Bituminous Road Construction in India, Prithvi Singh Kandhal, PHI

REFERENCES:

1. Highway Engineering: Pavements, Materials and Control of Quality, Athanassios Nikolaides, CRC Press, T&F
2. Pavement Engineering – Principles and Practice, Mallick R. B. and T. El-Korchi, CRC Press, Taylor and Francis Group, Florida, USA
3. IRC: SP:135-2022 ; Manual for the Design of Hot Bituminous Mixes

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ce93

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PC1HW02) TRAFFIC ENGINEERING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To introduce students on the basic concepts of traffic engineering
- To analyze capacity and level of service of highways
- To identify the importance and types of parking and traffic safety in day-to-day life
- To design signals at the intersection

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Explain basic characteristics of traffic engineering like speed, flow and density
CO-2: Analyze and calculate the capacity and level of service of any given highway
CO-3: Formulate the parking demand and design a parking facility
CO-4: Design the intersection

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	2	2	-	-	-
CO-2	1	2	2	-	2	-
CO-3	2	-	3	2	2	-
CO-4	2	-	3	-	-	2

UNIT-I:

Basic Traffic Stream Characteristics: Speed, flow and density, Relationship between Speed, Flow and density; Volume Studies - Objectives, Methods; Speed studies - Objectives: Definition of Spot Speed, time mean speed and space mean speed.

UNIT-II:

Traffic Measurement Procedures: Measurement at a Point (Volume data collection and analysis, PCU, PHF etc), Measurement over a Short Section (Speed data collection and analysis), Measurement along a Length of Road (Density and travel time measurement and analysis), Moving Observer Method, Traffic forecasting and growth studies.

UNIT-III:

Parking Studies and Analysis: Types of parking facilities - on street parking and off-street Parking facilities; Parking studies and analysis.

Traffic Safety: Accident studies and analysis; Causes of accidents; Engineering, Enforcement and Education measures for the prevention of accidents, Road safety audit.

UNIT-IV:

Traffic Intersection Control: Principles of Traffic Control and Traffic Signs, Road Markings and Channelization, Uncontrolled Intersection: Gap acceptance and capacity concepts, Uncontrolled Intersection: Capacity and LOS analysis, Highway Capacity and Level of Service: Basic definitions related to capacity; Level of service concept; Factors affecting capacity and level of service; Computation of capacity and level of service for two lane highways Multilane highways and freeways.

UNIT-V:

Traffic Control: Design Principles of Traffic Signal, Evaluation of a Traffic Signal: Delay Models, Capacity and LOS Analysis of a Signalized I/S, Coordinated Traffic Signal, Vehicle Actuated Signals and Area Traffic Control.

TEXT BOOKS:

1. Traffic Engineering and Transportation Planning, L. R. Kadiyali, Khanna Publishers
2. Traffic Engineering, Roger P. Roess, Elena S. Prassas and William R. McShane, 4th Edition, Prentice Hall
3. Traffic & Highway Engineering, Nicholas J. Garber, Lester A. Hoel, 3rd Edition, Bill

REFERENCES:

1. Fundamentals of Transportation Engineering C. S. Papacostas and P. D. Prevedouros, Prentice-Hall, New Delhi
2. Introductions to Traffic Engineering: A Manual for Data Collection and Analysis, Thomas R. Currin, Brooks/Cole Thomason Learning, Canada
3. Design Codes: IRC: SP: 41-1994, IRC SP: 31-1992, IRC 43-1994, Indian Roads Congress, New Delhi
4. Highway Capacity Manual 2010, Transportation Research Board
5. Indo-HCM, CSIR- CRRI, 2017, New Delhi

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ce41/preview
2. https://www.udemy.com/course/short-course-on-traffic-engineering/

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PC1HW03) HIGHWAY GEOMETRIC DESIGN

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand the various factors affecting pavement design
- To know design aspects and methods for rural and urban roads
- To introduce the principal of highway design, road safety and highway construction materials
- To applying the skills to design roads and select material for road construction

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Apply knowledge in fixation of ideal alignment and design of highway
CO-2: Describe design element: sight distance, horizontal curvature, super elevation, grades, visibility on vertical curves, cross section elements
CO-3: Use fundamental physics and mathematical knowledge in deriving geometric design equations
CO-4: Know the guidelines for the design of bus-bays, cycle tracks and pedestrian facilities

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	2	-	-	1
CO-2	1	-	3	-	2	-
CO-3	-	-	2	3	-	1
CO-4	2	2	2	3	2	2

UNIT-I:
Highway System: Functional Classification of Highway System, Highway Design Controls: Topography, Driver characteristics, Vehicle Characteristics, Traffic, Capacity and Level of Service, Design Speed - Objectives of Geometric Design - Cross Section Elements: IRC Design specifications, Pavement Surface characteristics: Skid Resistance, Road Roughness; Camber.

UNIT-II:
Geometric Design of Highway Element:
Sight Distances: Objectives, Types, factors affecting, Problems on Sight distance, Alignment: Types, Objective and Factors affecting alignment, Horizontal alignment: Objectives, design Criteria, super-elevation, extra widening and Design of transition curves. Vertical alignment: Objectives, design Criteria, Types of gradients, Grade

Compensation, design of summit and valley curves, combination of vertical and horizontal Alignment.

UNIT-III:

Intersection Design:

Introduction of Intersection Design: Objectives, Types of Intersections, Design Principles for Intersections. Design of At-grade Intersections: Objectives, Channelization, Traffic Islands and Design standards for intersection. Design of Rotary Intersection: Objectives, Advantages and Disadvantages and determining the capacity. Grade separated Interchanges: Objectives, Types, warrants and Design standards.

UNIT-IV:

Highway Design and Specifications:

Design Considerations: Design considerations for rural, urban arterials, expressways, and other rural Roads. Urban roads -design speeds, volumes, level of service - IRC Specification for Expressway and Rural Roads. Design of expressways, IRC standards and guidelines for design - Specifications for hill roads.

UNIT-V:

Active Transportation Facilities:

Pedestrian Facilities: Objectives of Pedestrian facilities, Types of Pedestrian facilities on Urban Roads and IRC Specification - Cycle Tracks: Objectives, Types of cycle track, Bus bays: Objectives, types, guidelines and IRC Design standards - Parking facilities: Objectives, Types, Guidelines and IRC Design standards.

TEXT BOOKS:

1. Principles and Practice of Highway Engineering, L. R. Kadiyali and N. B. Lal, Khanna
2. Traffic Engineering and Transportation Planning, L. R. Kadiyali and N. B. Lal, Khanna
3. Highway Engineering, S. K. Khanna, C. E. G. Justo and Veeraraghavan A., Nem Chand & Bros.

REFERENCES:

1. Transportation Engineering-An introduction, C. Jotin Khisty and B. Kent Lall, Prentice- Hall India
2. IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas
3. Design Codes IRC: SP: 41-1994, IRC SP: 31-1992, IRC 43-1994, Indian Roads Congress, New Delhi
4. Highway Capacity Manual 2010, Transportation Research Board
5. Indo HCM, 2017, CSIR CRRI, New Delhi

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW01) URBAN TRANSPORTATION PLANNING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To introduce basic concepts and methods of urban transportation planning in India
- To design, conduct and administer surveys to provide the data required for transportation planning
- To understand and apply travel demand modeling, mode choice modeling and traffic Assignment Modeling
- To identify importance of land-use characteristics in transportation planning

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Plan and conduct surveys to provide the data required for transportation planning

CO-2: Recognize zonal demand generation and attraction regression models.

CO-3: Develop and calibrate trip generation rates for specific types of land use developments

CO-4: Comprehend the relationship between land-use characteristics and urban transportation planning

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	2	-	-	1	-
CO-2	1	-	3	2	-	-
CO-3	2	2	3	2	-	-
CO-4	2	-	3	-	2	2

UNIT-I:

Basic Concepts of Transportation Planning: Goals and objectives - Hierarchical levels of Transportation planning - Forecast - Implementation - Constraints. UTP survey – Inventory of land use- Introduction of classical four stage modelling. Zonal Classifications. Applications of UTP- Preparation of alternative plans - Evaluation techniques – Plan implementation – Monitoring.

UNIT-II:

Trip Generation and Distribution Analysis: Trip generation and Trip Distribution Trip classification - productions and attractions - Multiple regression models - Category analysis - Trip production models - Trip distribution models – Linear programming approach.

UNIT-III:

Mode Choice Modelling: Behavioral models - Probabilistic models – Utility functions – logit models - Two stage model. Influencing Factors, Earlier Modal Split Models, Trip-End Type Modal Split Model, Trip-Interchange Modal Split Model, Disaggregate Mode-Choice Model, Logit Model of Mode Choice, Binary Choice Situations, Multinomial Logit Model, Model calibration.

UNIT-IV:

Traffic Assignment: Assignment methods – Route choice behaviour, The Minimum Path, All-or-Nothing Assignment, Multipath Traffic Assignment, Capacity-Restrained Traffic Assignment - Network analysis.

UNIT-V:

Land-Use and its Interaction: Lowry derivative models - non-Transport solutions for transport problems. Characteristics of urban structure; Urban Activity Systems, Urban Movement Hierarchies, Types of Urban Structure, Centripetal-Type Urban Structure, Grid Type Urban Structure, Linear-Type Urban Structure, Directional Grid Urban Structure Town planning concepts.

TEXT BOOKS:

1. Principles of Urban Transportation System Planning, Hutchinson B. G., McGraw Hill
2. An Introduction to Transportation Planning (The Living Environment), Bruton M. J., UCL Press
3. Transportation Engineering, C. J. Khisty and B. Kent Lall, Prentice Hall of India

REFERENCES:

1. Transportation Engineering and Planning, C. S. Papacostas and P. D. Prevedouros, Prentice Hall of India
2. UTP Lecture Notes, Chari S. R., Regional Engineering College, Warangal
3. Metropolitan Transportation Planning, Dicky J. W., Script Book Co.
4. Modelling Transport, Ortuzar J. and Willumsen L. G., Wiley, Chinchestor

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105107067

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW02) BRIDGE ENGINEERING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE PRE-REQUISITES: Structural Analysis I & II, Reinforced Concrete Design

COURSE OBJECTIVES:
- To understand the bridge hydrology
- To list the components of bridge substructure, superstructure and types of bearings
- To understand the codal provisions for loading and design standards of bridges
- To design RC and PSC bridges

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Determine flood discharge, waterway, economic span
CO-2: Select type of super structure, sub structure and the bearings
CO-3: Calculate the various types of loads acting on the bridges
CO-4: Design the Slab bridges, Girder bridges and Prestressed Concrete bridges

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	-	2	-	-	-
CO-2	2	-	2	-	-	-
CO-3	2	1	3	-	1	1
CO-4	3	1	3	-	1	1

UNIT-I:
Introduction: Components of a bridge, Classification of bridges, Requirements of an ideal bridge, Selection of bridge site, Choice of bridge type, Investigation for bridges.
Bridge Hydrology: Determination of flood discharge, Waterway, Economic span, Scour depth, Depth of foundation, Afflux, Clearance, Freeboard

UNIT-II:
Bridge Substructure and Super Structure: Bridge Piers, Abutments, Wing walls, Approaches, Types of bridge superstructures, Bridge flooring, Choice of superstructure type.

UNIT-III:
Standards of Loadings for Bridge Design: Types of loading for Road bridges – Dead load, Live load, Impact load, Wind loads, Lateral loads, Longitudinal forces, Centrifugal forces, Seismic loads, Forces due to water currents, Earth pressure,

Buoyancy, Temperature stresses Deformation stresses, Erection stresses, Requirements of traffic in the design of highway bridges.

UNIT-IV:

Reinforced Concrete Bridges: Design of Slab bridge, Design of Girder bridge, Courbon's theory.

UNIT-V:

Prestressed Concrete Bridges: Types of prestressing – Pre tensioning, Post tensioning, Pretensioned PSC bridges, Post tensioned PSC bridges.

Bridge Bearings and Expansion Joints: Functions, types and selection of bearings - Bearing materials - Design of elastomeric bearings for different conditions - Expansion joints – types of expansion joints.

TEXT BOOKS:

1. Principles and Practice of Bridge Engineering, S. P. Bindra, Dhanpat Rai
2. Design of Concrete Bridges, M. G. Aswani, V. N. Vazirani, M. M. Ratwani, Khanna
3. Essentials of Bridge Engineering, D. J. Victor, Oxford & IBH Publishing Co.

REFERENCES:

1. Design of Bridge Structures, T. R. Jagdeesh and M. A. Jayaram, PHI
2. Bridge Engineering, Ponnuswamy S., Tata McGraw Hill
3. Analysis and Design of Substructures, Swami Saran, Oxford & IBH Publishing Co.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW03) INTELLIGENT TRANSPORTATION SYSTEMS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand ITS architecture and standards
- To apply appropriate ITS technology depending upon site specific conditions
- To design and implement ITS components
- To understand concept and application of Automated Highway Systems

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Differentiate different ITS user Services
CO-2: Apply ITS for road user safety
CO-3: Comprehend different ITS simulation techniques
CO-4: Interpret importance of AHS in ITS

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	-	2	2	-
CO-2	2	1	3	2	1	-
CO-3	2	-	3	-	3	-
CO-4	-	2	3	2	-	3

UNIT-I:

Introduction To ITS: System Architecture, Standards, Database – Tracking Database – Commercial Vehicle Operations – Intelligent Vehicle Initiative - Metropolitan ITS – Rural ITS – ITS for Rail network., Implementation of ITS- ITS programs globally- overview of ITS in developed countries and developing countries

UNIT-II:

ITS Travel Management: Autonomous Route Guidance System – Infrastructure based systems – Telecommunications – Vehicle – Road side communication – Vehicle Positioning System – Electronic Toll Collection – Electronic Car Parking

UNIT-III:

ITS Designs: Modelling and Simulation Techniques - Peer – to – Peer Program – ITS for Road Network – System Design – Mobile Navigation Assistant – Traffic Information Center – Public Safety Program.

UNIT-IV:

Automated Highway Systems: Evolution of AHS and Current Vehicle Trends - Vehicles in Platoons – Aerodynamic Benefits - Integration of Automated Highway Systems – System Configurations - Step by Step to an Automated Highway System.

UNIT-V:

Spacing and Capacity for Different AHS Concepts: Spacing and Capacity for Different AHS Concepts – Communication Technologies for AHS - The Effects of AHS on the Environment – Regional Mobility - Impact Assessment of Highway Automation.

TEXT BOOKS:

1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC), Kan Paul Chen, John Miles
2. Intelligent Transport Systems – Cases and Policies, Roger R. Stough, Edward Elgar
3. Intermodal Freight Transport, David Lowe, Elsevier Butterworth-Heinemann

REFERENCES:

1. Positioning Systems in Intelligent Transportation Systems, Chris Drane and Chris Rizos, Artech House Publishers
2. Perspectives on Intelligent Transport Systems, Joseph M. Sussman, Springer
3. Intelligent Transport System, Intelligent Transportation Primer, Washington, US

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW04) TRANSPORTATION DATA ANALYSIS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand different data presentation techniques
- To apply appropriate probability distribution laws
- To test different statistical hypothesis
- To analyze multivariate transportation data

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Select a suitable method for processing and presentation of transportation data

CO-2: Apply probability distributions to analyze transportation data

CO-3: Choose appropriate hypothesis testing measures

CO-4: Analyze multivariate transportation data using curve fitting techniques

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	-	2	-	-	2
CO-2	2	-	2	-	1	-
CO-3	-	2	3	2	-	-
CO-4	-	2	3	2	2	-

UNIT-I:

Data Description and Presentation: Type of data, a centre of data, quartiles, five-number summary, the spread of data, coefficient of variation and standard deviation, a measure of dispersion, shape of data, coefficients of skewness and kurtosis, descriptive data statistics, presentation of categorical, quantitative and qualitative variable, data frequency and histogram, exercises with actual data.

UNIT-II:

Probability Laws and Distribution: Basic probability theory, concept and rules, Bayes' theorem, type of statistical distribution and characteristic, probabilistic distributions-Binomial, Poisson, Normal, Lognormal, Weibull, Gamma, Beta, Erlang, Student's t and F distribution, Geometric and Hyper geometric distribution, applications in transportation engineering.

UNIT-III:

Statistical Inference and Tests of Significance: Hypothesis testing, types of error in hypothesis, confidence interval, significance tests for comparing variances and

means, tests with small and large samples, two-tail and one-tail student's t-test, analysis of variance (ANOVA), non-parametric tests (Chi-square test and Kolmogorov–Smirnov test), central limit theorem, practice with transportation data.

UNIT-IV:

Regression and Correlation: Simple linear regression, residuals and variances, multiple linear regression, two-stage regression, forward, backward and step-wise regression, residual analysis, correlation analysis, type of correlations, coefficient of correlation, Karl-Pearson's coefficient, multivariate data analysis, factor analysis, applications in transportation engineering,

UNIT-V:

Parameter Estimation and Curve Fitting Techniques: Least square, generalized least squares, method of moments, maximum likelihood, algebraic and geometric curve fit, linear and non-linear curve fitting (polynomial, exponential, logarithmic, power, etc.), overfit, and under fit.

TEXT BOOKS:

1. Statistical and Econometric Methods for Transportation Data Analysis, Washington, S. P., Karlaftis M. G., Mannering F., Anastasopoulos P., CRC Press
2. Statistical Techniques for Transportation Engineering, Molugaram K., Rao G. S., Shah A., Davergave N., Butterworth-Heinemann
3. Multivariate Data Analysis, Joseph F. H., William C. B., Barry J. B., Anderson R. E., Prentice Hall

REFERENCES:

1. Probability and Statistical Inference, Robert V. H., Elliot T., Zimmerman D., Pearson
2. Probability Concepts in Engineering Planning and Design, Alfredo H. S. A., Tang, W. H., Volume I & II, John Wiley & Sons
3. Quality Improvement through Statistical Methods, Bovas A., Springer Science & Business Media

ONLINE RESOURCES:

1. http://courses.washington.edu/cee412/
2. https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1GT01) SOIL STRUCTURE INTERACTION

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To introduce the concepts and terminology of soil structure interaction
- To analyze different type of framed structures resting on natural deposits
- To develop knowledge on behavior of piles and pile groups on soils
- To create and formulate advance programming to solve interaction problems

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics

CO-2: Prepare comprehensive design-oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

CO-3: Analyze different types of frame structure founded on stratified natural deposits with Linear and non-linear stress-strain characteristics

CO-4: Understand action of group of piles considering stress-strain characteristics of real soils

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	1	3	2	1	1
CO-2	3	1	3	2	3	1
CO-3	3	1	3	1	1	1
CO-4	3	1	3	1	1	1

UNIT-I:

Importance of Soil Structure Interaction: Critical Study of Conventional Methods of Foundation design, Nature and Complexities of Soil Structure Interaction.

UNIT-II:

Numerical Techniques in SSI: Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method

UNIT-III:

Simulation Program: Effect of seismic load on structure interaction, Preparation of Comprehensive Design Oriented Computer Programs for simple seismic soil structure interaction model, Interaction of Beams, Footings, Rafts Etc. based on Sub Grade Reaction.

UNIT-IV:

Soil Structure Interaction of Framed Structure: Analysis of Different Types of Framed Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

UNIT-V:

Analysis of Laterally and Axially Loaded Pile Groups: Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

TEXT BOOKS:

1. Analytical and Computer Methods in Foundation, Bowels J. E., McGraw Hill Book Co., 1974
2. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A. P. S, Elsevier
3. Numerical Methods in Geotechnical Engineering, Desai C. S. and Christian J. T., McGraw Hill

REFERENCES:

1. Soil Structure Interaction - The Real Behaviour of Structures, Institution of Structural Engineers
2. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engineering, Vol.17, Elsevier
3. Analysis & Design of Substructures, Swami Saran, Oxford & IBH
4. Design of Foundation System-Principles & Practices, Kurian N. P., Narosa Publishing

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW05) REMOTE SENSING AND GIS APPLICATIONS IN HIGHWAYS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To describe and define various concepts of Remote Sensing and GIS
- To analyze data using GIS
- To appraise the importance of accuracy in GIS
- To apply GIS knowledge in solving various problems in real world scenario

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Describe different concepts and terms used in Remote Sensing and GIS

CO-2: Compare and process different data sets

CO-3: Evaluate the accuracy and decide whether a data set can be used or not

CO-4: Demonstrate various applications of GIS in highway engineering

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	2	3	1	-	-
CO-2	1	-	-	2	3	-
CO-3	1	2	-	2	-	3
CO-4	2	-	3	-	3	2

UNIT-I:

Remote Sensing: Introduction- Principle of remote sensing, components of remote sensing, Remote sensing platforms, Radiometric quantities, Electromagnetic radiation and its properties, Electromagnetic energy laws, Interaction of EMR with earth features, Interaction of EMR with atmospheric features, atmospheric effects on remote sensing data, spectral reflectance curves, Spectral properties of soil, water, vegetation. Advantages and Disadvantages of Remote Sensing Data

UNIT-II:

Satellites and Sensors: Sensors - Remote sensing sensors types, along track scanners, across track scanners. Sensor Characteristics – Swath, IFOV, Nadir view, Spatial Resolution, Spectral Resolution, Temporal, Resolution, Radiometric resolution, Atmospheric, Radiometric, Geometric corrections Satellites – Satellite orbits, Geostationary and polar satellites, various satellites and their main applications, IRS satellites.

UNIT-III:

Remote Sensing Data Interpretation, Processing and Enhancement: Elements of visual interpretation, Image enhancement techniques - necessity and importance, contrast enhancement techniques, low pass (smoothing) filters and high pass (sharpening) filters, linear and non-linear filtering techniques, edge detection, supervised classification, unsupervised classification, and Classification accuracy. Introduction to GPS and DGPS.

UNIT-IV:

Geographical Information System: Introduction, Definition and Terminology, Maps and Map Scale, Geo referencing and Projection, Components of GIS, GIS Data Input and output, GIS Data Models – Raster, Vector, TIN, Advantages and disadvantages, Spatial Data Analysis: Vector Operations and Analysis- Single theme and multi themes, Raster data analysis, Interpolation – global and local methods

UNIT-V:

Applications of GIS in Transportation Engineering: GIS based road network planning, , Identification of accident hot spots using GIS, Automatic Navigation system using GPS and GIS, Shortest path applications in GIS, Intelligent transportation systems.

TEXT BOOKS:

1. Remote Sensing and Image Interpretation, Thomas M. Lillesand and Ralph W. Kiefer, Wiley s
2. Introduction to Geographic Information systems, Kang-tsung Chang, McGraw Hill Education
3. Remote Sensing and GIS, Basudeb Bhatta, Oxford University Press

REFERENCES:

1. Basics of Remote sensing and GIS, Dr. S. Kumar, Laxmi Publications
2. Remote Sensing and Geographical Information systems, M. Anji Reddy, B. S. Publications
3. Remote Sensing and Geographical Information systems, Kali Charan Sahu, Atlantic Publishers and Distributors

ONLINE RESOURCES:

1. https://transportgeography.org/contents/methods/geographic-information-systemstransportation/
2. https://www.esri.com/library/bestpractices/urban-regional-planning.pdf48
3. https://www.gis.fhwa.dot.gov/documents/gis_assetmgmt.pdf

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW06) ROAD SAFETY AND TRAFFIC MANAGEMENT

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To apply the principles of a systems approach to the analysis of risk factors for road traffic injuries
- To apply methods for reducing traffic impacts on communities such as traffic calming strategies, accident reductions and parking management
- To discuss the key risk factors for road traffic injuries
- To understand the role of ITS in dynamic traffic management

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Explain the factors for road traffic injuries
CO-2: Analyze and provide solutions for traffic calming and parking management
CO-3: Evaluate the risk factors for road traffic injuries
CO-4: Understand the role of ITS in dynamic traffic management

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	2	-	2	-	1
CO-2	-	2	3	-	1	2
CO-3	2	3	-	2	-	-
CO-4	-	-	3	-	3	1

UNIT-I:

Introduction to Crashes: Characteristics of crashes – Human, Vehicle, Road and Environmental factors; Scientific investigations and crash data collection; Crash investigation and analysis – Crash report forms, using and interpreting crash data, condition and collision diagrams; Crash reconstruction – understanding basic physics, calculation of speed for various skid, friction, drag and acceleration scenarios.

UNIT-II:

Statistical Analysis of Crashes: Statistical analysis of crashes, various methodological issues – over/under-dispersion, under reporting, unobserved heterogeneity, endogeneity etc., Safety Performance Functions – models related to crash frequency, crash severity and collision types; Identification of hazardous crash locations. Before and after crash studies – with controlled sites, comparative parallel study and other methods.

UNIT-III:

Road Safety Audits: Procedure, aims and objectives, roles and responsibilities, history of Road Safety Audits (RSA), design standards, tasks, various stages of safety audits, common identifiable problems, identifying common problems, suggesting mitigation measures and structuring of the RSA report.

UNIT-IV:

Traffic Management Techniques: Integrated Safety improvement and Traffic Calming Schemes, speed and load limit, Traffic light, safety cameras, highway patrolling, Test on driver and vehicles, pedestrian safety issues, parking, Parking enforcement and its influences on accidents. Travel demand management. Incident management-characteristics of traffic incidents, types of incidents, Impacts, Incident management process, Incident traffic management

UNIT-V:

Method of Traffic Management Measures: Restrictions of Turning movements, One-way streets, Tidal Flow operation methods, Exclusive bus lanes and closing side – streets; latest tools and techniques used for road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost Road Accidents. Applications of ITS in-traffic management.

TEXT BOOKS:

1. Observational Before-After Studies in Road Safety, Ezra Hauer, Pergamon Press
2. Statistical and Econometric Methods for Transportation Data Analysis, Simon P. Washington, Matthew G. Karlaftis, Fred L. Mannering, 2nd Edition, Chapman and Hall, CRC Press
3. Traffic Collision Investigation, J. Stannard Baker, North-Western University Centre for Public Safety

REFERENCES:

1. Traffic Control and Road Accident Prevention, Popkess C. A. Chapman and Hall
2. The Handbook of Road Safety Measures, Rune Elvik and Truls V., Elsevier
3. Statistical and Econometric Methods for Transportation Data Analysis, Simon Washington, Matthew K., and Fred Mannering, Chapman & Hall/CRC Press

ONLINE RESOURCES:

1. http://tripp.iitd.ernet.in/publication/report
2. https://atpio.org/webinar-on-addressing-road-safety-worldwide-vulnerable-road-usershuman-factors-rs-in-lmic/

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW07) ENVIRONMENTAL IMPACT ASSESSMENT FOR HIGHWAY PROJECTS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To assess environmental impacts of road traffic under various policy options Estimate air pollution concentrations as a function of emission, meteorology, topography and they built environment from road traffic
- To promote the integration of all forms of transport and land use planning, leading to a better, more efficient transport system
- To plan, develop and manage land transport system to support a quality environment while making optimal use of our transport and safeguarding the well-being of the travelling public
- To deliver an effective land transport network that is integrated, efficient, cost-effective and sustainable to meet the nation's needs

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Understand national and international contexts on transport and the environment. Basic understanding of the concepts of traffic and environment management for sustainability

CO-2: Gain Knowledge on policies and reports which have a strong bearing on local and global air pollution and sustainability issues.

CO-3: Appreciate the multiple complexities of successful planning, data collection and analysis and identification of improvements

CO-4: Realize to current issues relating to traffic flow, road safety and air quality

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	-	2	-	2
CO-2	3	-	-	2	-	2
CO-3	2	2	-	3	-	-
CO-4	-	-	3	--	2	-

UNIT-I:

Introduction: Environment and its interaction with human activities – Environmental imbalances. Attributes, Impacts, 'Indicators and Measurements - Concept of Environmental Impact Assessment (EIA); Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA

UNIT-II:

Environmental Indicators: Indicators for climate - Indicators for terrestrial subsystems - Indicators for aquatic subsystems - Selection of indicators - Socio-economic indicators

– Basic information - Indicators for economy - Social indicators - Indicators for health and nutrition - Cultural indicators - Selection of indicators.

UNIT-III:

Environmental Issues: Water resource development - Land use - Soil erosion C1nd their short- and long-term effects - Disturbance and long-term impacts - Changes in quantity and quality of flow ¬Sedimentation

Environmental Assessment: Water resource development structures – Case studies, Water Quality Impact Assessment - Attributes, Water Quality Impact Assessment of Water

UNIT-IV:

Project Resources: Data Requirements of Water Quality Impact Assessment for Dams, Impacts of Damson Environment, Case Studies. Environmental Issues in Industrial Development: On-site and Off-site impacts during various stages of industrial development, long term climatic changes, Greenhouse effect, Industrial effluents and their impaction natural cycle, Environmental impact of Highways, Mining and Energy development

UNIT-V:

Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies. Ad hoc, Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing a Methodology, Review Criteria.

TEXT BOOKS:

1. Environmental Impact Assessment, Canter, L.W., McGraw Hill
2. Environmental Analysis of Transportation Systems, Louis Franklin Cohen and Gary Richard Mc Voy, John Wiley
3. Environmental Impact Analysis, Jain R. K., Urban L. V., Stracy G. S., Nostrand Reinhold Co.

REFERENCES:

1. Environmental Fate and Transport Analysis with Compartment Modeling, Keith W. Little, CRC Press, Taylor & Francis Group
2. NCHRP Report 541, Consideration of Environmental Factors in Transportation Systems Planning, TRB
3. NCHRP Synthesis 272, Best Management Practices for Environmental Issues Related to Highway and Street Maintenance: A Synthesis of Highway Practice, National Research Council, TRB

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PE1HW08) MASS TRANSPORTATION SYSTEM AND PLANNING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand and apply basic concepts and methods of Mass transportation system and planning in India
- To learn Transit system, types of transit modes, characteristics of transit system for understanding transit system and estimation of transit demand based on origin and destination surveys
- To understand and be able to apply bus route network planning and route system
- To understand mass transit corridor identification and planning

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify various Mass transport system and their characteristics
CO-2: Asses public transport and development strategies
CO-3: Planning of mass transit systems
CO-4: Evaluation of transit performance and its impact on network analysis

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	-	-	1	-
CO-2	1	-	3	2	-	1
CO-3	1	-	3	2	2	-
CO-4	-	2	3	-	2	-

UNIT-I:
Transit System and Issues: Introduction to Mass Transport – Role of various modes of Mass Transport – Problems and their Impact – System Characteristics: Technological Characteristics – Resistances, acceleration & velocity Profiles – Operational characteristics speed, capacity & payloads – Route capacity – Comfort conditions - Performance relationships - Public and Private Operations - Modes for Intercity Transport System Performance at National, State, Local and International levels

UNIT-II:
Public Transit System: Urban Transport System – Public Transport System Re-genesis and Technology – Physical performance of Public Transport System – Public Transport and Urban Development Strategies - Characteristics of Rail Transit – Vehicle Characteristics, ITS, Para transit systems – Intermediate Public Transport.

UNIT-III

Mass Transit Corridor Identification & Planning: Corridor identification – Network Compression Method - Planning of Rapid Transit System - System Selection - Supporting and Enclosing Structures - System Evaluation - Track Structures - Power Supply and Distribution - Signal System – Aesthetics and Noise Consideration - Cost of Construction - Station Arrangements - Platform Capacity - Fare Collection, Transit Marketing.

UNIT-IV:

Bus Transit Planning and Scheduling: Route Location, Route Structure, Route Coding Techniques, Route Capacity - Planning of Transit Network - Different Types - Service Area Coverage - Evaluation - Selection of Optimal Network - Path Building Criteria - Route Planning and Scheduling – Bus Transport System – Performance and Evaluation – Scheduling – Conceptual patterns of bus service – Network Planning and Analysis – Bus Transport System Pricing – Bus Transit System Integration – Analytical Tools and Techniques for Operation and Management – Bus Rapid Transit Systems.

UNIT-V:

Rail Transit Terminals and Performance Evaluation: Performance Evaluation – Efficiency, Capacity, Productivity and Utilisation – Performance Evaluation Techniques and Application – System Network Performance – Transit Terminal Planning and Design Urban Rail Transit Planning – MRTS – LRTS, Metro Rail – Monorail – Network Design, Capacity and Traffic Fore casting

Impact of Transit: Impact of Transport Development on Environment – Remedial measures – Policy Decisions – Recent Trends in Mass Transportation Planning and Management.

TEXT BOOKS:

1. Urban Mass Transport Planning, Black, McGraw Hill
2. Urban Public Transport System and Technology, V. R. Vuchic, Prentice Hall Inc.
3. Fundamentals of Transportation Engineering, C. S. Papacostas, Prentice Hall India

REFERENCES:

1. Public Transport Planning Operation and Management, G. E. Gray, C. A. Hoel, Prentice Hall
2. Planning for Public Transport, White P. R., UCL Press Ltd.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PC1GT03) GROUND IMPROVEMENT TECHNIQUES

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To know the needs and objectives of ground improvement techniques
- To comprehend the principles of various ground improvement methods
- To compare different methods of ground improvement and understand their suitability
- To apply the relevant method to remedy a difficult soil condition

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the principles of ground improvement to a given site conditions
CO-2: Select the choice of right technique to improve different difficult grounds
CO-3: Estimate safety, stability of economical construction of any structure
CO-4: Identify the issues affecting design and construction of various methods for soil improvement

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	1	3	1	1	1
CO-2	3	-	2	-	1	1
CO-3	3	1	1	1	3	1
CO-4	3	-	2	1	3	1

UNIT-I:
Introduction to Ground Modification: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility.

UNIT-II:
Mechanical: Methods of compaction, Shallow compaction, Deep compaction techniques - Vibro-floatation, Blasting, Dynamic consolidation, pre-compression and compaction piles, Field compaction control.

UNIT-III:
Hydraulic Modification: Hydraulic Modification: Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains.

UNIT-IV:

Physical and Chemical Modification: Stabilization with admixtures like Cement, Lime, Calcium Chloride, fly Ash and Bitumen. Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control.

UNIT-V:

Soil Confinement Systems: Soil reinforcement: Reinforced earth, basic mechanism, type of reinforcements, selection of stabilisation/improvement of ground using Geotextiles, Goegrid, geomembranes, geocells, geonets, and soil nailing.

TEXT BOOKS:

1. Engineering Principles of Ground Modifications, Hausmann M. R., McGraw Hill, 1990
2. Designing with Geosynthetics, Koerner R. M., Prentice Hall, 1994

REFERENCES:

1. Engineering Principles of Ground Modification, Hausmann M. R., McGraw-Hill International Edition, 1990
2. Grouting and Deep Mixing, Yonekura R., Terashi M. and Shibazaki M. (Eds.), A. A. Balkema, 1966
3. Ground Improvement, Moseley M. P., Blackie Academic & Professional, 1993
4. Earth Reinforcement and Soil Structures, Jones C. J. F. P., Butterworths, 1985
5. Ground Control and Improvement, Xianthakos Abreimson, Bruce, John Wiley, 1994

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PC2HW01) PAVEMENT ENGINEERING LABORATORY

TEACHING SCHEME		
L	T/P	C
0	2	1

EVALUATION SCHEME					
D-D	PE	LR	CP	SEE	TOTAL
10	10	10	10	60	100

COURSE OBJECTIVES:

- To learn the properties of aggregate used in pavement constructions
- To design the base courses of pavement layers
- To understand the grading of bitumen binders
- To gain Knowledge on design of bituminous mix using Marshall Process

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Identify the suitability of aggregate used in pavement constructions
CO-2: Evaluate the design process for base course layers
CO-3: Appreciate different tests performed on bitumen grading
CO-4: Understand how to perform bituminous mix design

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	2	3	-	-	1
CO-2	2	3	2	1	2	1
CO-3	-	3	2	-	2	2
CO-4	-	3	2	1	2	2

TESTS ON AGGREGATES:

1. Aggregate Impact Test
2. Los Angeles Abrasion Test
3. Crushing strength of Aggregates
4. Specific Gravity and Water Absorption Test
5. Soundness test
6. Mix Design for base layers:
    a) Wet Mix Macadam
7. Bitumen & Bituminous Mixes: Bitumen grading:
8. Absolute & Kinematic Viscosity
9. Penetration Test
10. Softening point
11. Flash & fire point

MIX DESIGN:

1. Bituminous concrete mix design – Marshall method
2. Determination Binder content

REFERENCES:

1. Highway materials and pavement testing, Khanna S. K., Justo C. E. G., and A. Veeraragavan, Nem Chand and Brothers
2. Pavement Analysis and Design, Huang Y. H., Pearson Prentice Hall
3. Relevant IS, IRC, ASTM Codes.
   Note: All tests are performed as per IS, ASTM, AASHTO, TRL, IRC, BS procedures / specifications and guidelines

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22PC2HW02) TRAFFIC ENGINEERING FIELD LABORATORY

TEACHING SCHEME		
L	T/P	C
0	2	1

EVALUATION SCHEME					
D-D	PE	LR	CP	SEE	TOTAL
10	10	10	10	60	100

COURSE OBJECTIVES:

- To perform traffic surveys and to retrieve different traffic stream parameters
- To analyze capacity and level of service of highways
- To design different types of parking facilities and characteristics
- To assess driver characteristics and pollution parameters due to traffic

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand the data collection procedure for traffic volume, speed, headway, gap acceptance behaviour and parking surveys
CO-2: Knowledge of different level of service and capacity estimation
CO-3: Appreciate the driver characteristics and reaction time
CO-4: Realize pollutants emitted by vehicles and their standards

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	2	3	-	-	1
CO-2	2	3	2	-	-	1
CO-3	-	3	2	-	-	2
CO-4	-	-	2	-	-	2

LIST OF EXPERIMENTS:

1. Classification of Traffic Volume at Mid-Block and Intersections.
2. Speed Studies analysis.
3. Headway studies: Time and Space diagrams – Car following method.
4. Gap acceptance studies.
5. Travel Time and Delay Studies by Floating Car Method at Mid-Block.
6. Intersection delay studies at Uncontrolled and Signalized Intersection.
7. Parking surveys: Parking Inventory and Turnover Studies.
8. Highway Capacity Estimation.
9. Traffic Noise Measurement – Noise Contour
10. Analysis of Vehicular Pollutants from Exhaust Gases – 5 Gas Analyzer (CO2, CO, NOx and HC).

REFERENCES:

1. Transportation Engineering: An Introduction, Jotin and, B. Kent Lall, Prentice Hall

2. Introduction to Traffic Engineering: Manual F/Data Collect & Analysis, Currin, CL Engineering
3. Traffic Engineering and Transportation Planning, L. R. Kadiyali, Khanna Publishers

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22SD5HS01) COMMUNICATION SKILLS FOR ACADEMIC AND RESEARCH WRITING

TEACHING SCHEME		
L	T/P	C
0	2	1

EVALUATION SCHEME					
D-D	PE	LR	CP	SEE	TOTAL
10	10	10	10	60	100

COURSE OBJECTIVES:

- To equip the students with an understanding of the mechanics and conventions of academic and research writing including cohesion and coherence to produce texts that demonstrate precision and clarity
- To enable students to present focused, logical arguments that support a thesis
- To empower the students to find, analyze, evaluate, summarize and synthesize appropriate source material for literature review
- To enable students to use appropriate language to analyze and interpret the data, and prepare an outline
- To enable students to become adept in the requirements and specifications of standard writing to produce academic and research papers

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Apply knowledge of academic language features, and text structure and ensure cohesion and coherence as connected to various text types

CO-2: Demonstrate the use of writing process strategies through outlining, reviewing, composing, and revising

CO-3: Evaluate sources and use summary, analysis, synthesis, and integration to construct a literature review on a topic chosen by the student

CO-4: Prepare an outline for Research Articles and Thesis

CO-5: Apply standard documentation style to produce academic and research papers that meet the demands of specific genres, purposes, and audiences

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	3	3	1	-	2
CO-2	2	3	3	1	-	2
CO-3	2	3	3	1	-	2
CO-4	3	3	3	1	-	1
CO-5	3	3	3	1	-	2

UNIT-I:

a) Factors Influencing Effective Writing: Mechanics of Writing, Purpose of Writing, Audience/reader, Organisation- Cohesion, and Coherence

b) Features of Academic Writing: Introduction, Complexity, Formality, Precision, Objectivity, Explicitness, Accuracy and Appropriacy, Relevance, Hedging

UNIT-II:

1. Academic Writing Forms:

a) Analysing arguments; Building an argument
b) Making a Counter Argument- Managing tone, and tenor

2. Types of Research: Primary and Secondary Research;
3. Research Design: Statement of the Problem, Survey of relevant literature, Writing Hypotheses, Developing Objectives; Research Tools

UNIT-III:

a) Criteria of Good Research- Avoiding Plagiarism
b) Data Interpretation
c) Preparing an outline for Research Articles & Research Reports

UNIT-IV:

a) Reference Skills -Paraphrasing (Change of parts of speech, word order, synonyms, using the passive form), -Summarizing (Steps in summarising)
b) Documentation Format: APA style
c) Documentation Format: MLA style

UNIT-V:

a) Writing Article Reviews
b) Report Writing: a) Writing Technical Reports b) Writing Proposals

TEXT BOOKS:

1. A Course in Academic Writing, Gupta R., Orient Black Swan, 2010
2. Academic Writing: Exploring Processes and Strategies, Leki I., CUP, 1998
3. Writing-up Research: Experimental Research Report Writing for Students of English, Weissberg R., & Buker S., Englewood Cliffs, Prentice Hall, 1990

REFERENCES:

1. English Academic Writing for Students and Researchers. Yakhontova T., 2003
2. Inside Track: Successful Academic Writing, Gillett A., Hammond A., Martala M., Pearson Education, 2009
3. English for Academic Research: Writing Exercises, Wallwork, Springer, 2013
4. The MLA Handbook for Writers of Research Papers, 7th Edition, Modern Language Association
5. Academic Writing for Graduate Students: A Course for Non-native Speakers of English, Swales J. M., & Feak C. B., University of Michigan Press, 1994

ONLINE RESOURCES:

1. https://www.coventry.ac.uk/study-at-coventry/student-support/academic-support/centre-for-academic-writing/support-for-students/academic-writing-resources/
2. https://www.biz-e-training.com/resources-for-learners/academic-writing-online-resources/

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester

(22MN6HS01) REASEARCH METHODOLOGY AND IPR

TEACHING SCHEME		
L	T/P	C
2	0	0

EVALUATION SCHEME			
SE-I	SE-II	SEE	TOTAL
50	50	-	100

COURSE OBJECTIVES:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Understand research problem formulation

CO-2: Analyze research related information & Follow research ethics

CO-3: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity

CO-4: 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

CO-5: 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

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	-	2	2	3	3
CO-2	3	-	2	2	3	3
CO-3	3	2	-	2	-	3
CO-4	3	2	-	2	-	3
CO-5	3	2	-	2	-	-

UNIT–I:

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–II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT–III:
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–IV:
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–V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. 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

TEXT BOOKS:

1. Research Methodology: An Introduction for Science & Engineering Students, Stuart Melville and Wayne Goddard
2. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville
3. Research Methodology: A Step by Step Guide for beginners, Ranjit Kumar, 2nd Edition

REFERENCES:

1. Resisting Intellectual Property, Halbert, Taylor & Francis Ltd., 2007
2. Industrial Design, Mayall, McGraw Hill, 1992
3. Product Design, Niebel, McGraw Hill, 1974
4. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016
5. Intellectual Property Rights Under WTO, T. Ramappa, S. Chand, 2008

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PC1HW04) PAVEMENT ANALYSIS AND DESIGN

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand the design factors considered for the design of flexible and rigid pavements
- To estimate the stresses and strains in flexible pavement from layer theories
- To determine the stresses and strain for rigid pavement analysis
- To learn various design methods for flexible and rigid pavement

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Explain the design factors used for flexible and rigid pavements

CO-2: Determine the stresses and strains in a flexible pavement using the multi-layered elastic theory and KENPAVE

CO-3: Compute stresses and strains in a rigid pavement using Westergaard's theory and KENSLABS

CO-4: Design flexible and rigid pavement using various methods

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	-	-	-	1	2
CO-2	3	1	3	2	3	
CO-3	3	1	3	2	3	-
CO-4	3	2	3	2	2	2

UNIT–I:

Introduction: Historical development of pavements; Introduction to different types of flexible pavements; Road Pavements and pavement layers - types, functions, choice Factors affecting design, Introduction to traffic loading, Understanding the concept of equivalent standard axle load (ESAL), ESWL, EWL, VDF due to varying loads.

UNIT–II:

Stresses and Deflection / Strain in Flexible Pavements: Application of elastic theory, stresses, deflections / strains in single, two layer and multi-layer system, Analysis of pavements using software such as IITPAVE and KENPAVE.

UNIT–III:

Flexible Pavement Design: Empirical, semi-empirical, and theoretical design approaches, principle, advantages, and application; Outline of other common design methods such as AASHTO: Mechanistic-Empirical Pavement Design Guide - I

(MEPDG); Flexible Pavement Design as per IRC:37-2018; Overlay design - flexible pavements as per IRC guidelines IRC:115-2014

UNIT–IV:

Stresses in Rigid Pavements: Types of stresses and causes; Introduction to Westergaard's equation for calculation of stresses in rigid pavements due to wheel loads and temperature; Considerations in rigid pavement analysis, wheel load stresses, warping stresses, frictional stresses, combined stresses, KENSLAB.

UNIT–V:

Rigid Pavement Design: Design of cement concrete pavements for highways; PCA and AASHTO Methods: Design of joints, reinforcements, tie bars, dowel bars and slab thickness as per IRC 58 2015. Design features of continuously reinforced concrete pavements. Mechanistic-Empirical Pavement Design Guide - II (MEPDG). Overlay design - flexible pavements as per IRC guidelines IRC:117-2015

TEXT BOOKS:

1. Pavement Design and Materials, Papagiannakis A. T. and E. A. Masad, John Wiley
2. Pavement Analysis and Design, Huang Y. H., 2nd Edition, Dorling Kindersley (India)
3. Asphalt Institute, Thickness Design – Asphalt Pavements for Highways and Streets Manual Series No. (MS-2), Asphalt Institute

REFERENCES:

1. The Design and Performance of Road Pavements, Croney D. and P. Croney McGraw Hill Book
2. Mechanistic-Empirical Pavement Design Guide, A Manual of Practice, Interim Edition, Publication Code: MEPDG-1, American Association of State Highway and Transportation Officials (AASHTO)
3. IRC: 37-2018 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi, India
4. IRC:58-2015 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, The Indian Roads Congress, India
5. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, India

ONLINE RESOURCES:

1. http://onlinepubs.trb.org/onlinepubs/archive/mepdg/home.htm
2. http://www.asphaltinstitute.org/thicknessdesignsw/ (30 days trial version)

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PC1HW05) HIGHWAY PROJECT FORMULATION AND ECONOMICS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To introduce the economic evaluation concepts for preparation of detailed project report
- To understand the computation of road user cost for evaluation of highway projects
- To analyze basic methods of economic analysis carried for highway engineering projects
- To recognize the importance of EIA for transportation engineering projects

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Classify the requirements for Preparation of Project and components in Highway Planning
CO-2: Fundamental knowledge in estimation of road user costs and methodologies for economic evaluation of accidents
CO-3: Estimate transportation project feasibility using economic methods.
CO-4: Explain factors in environmental impact assessment for highway projects

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	2	2	-	-	-
CO-2	2	1	2	-	2	1
CO-3	2	2	2	3	-	-
CO-4	-	-	2	3	-	2

UNIT–I:
Project Formulation: Requirements in project formulation; non-monetary and monetary Criteria in formulation of project- Preparation of DPR – Guidelines- Development of cash flow diagrams; Cost and benefit components; Discounting criteria.

UNIT–II:
Project Planning: Highway Planning importance; Road Network project development; need for economic evaluation; principles of economic evaluation- welfare economics; social costs, vest charge

UNIT–III:
Highway Economics Parameters: Road user costs – Issues in travel time savings - concept and evaluation of travel time savings; Vehicle operating costs: components

of VOC, road user cost study in India; Accident costs: Methodologies for economic evaluation of an accident; Basic methods of economic analysis.

UNIT–IV:

Methods of Economics Evaluation: Basic methods of economic analysis: Equivalent Uniform Annual Cost Method; Present worth of cost method; Equivalent uniform annual net return method; Net present value method; Benefit cost ratio method; Rate of Return Method- Applications of these methods in highway projects. Highway financing- Project appraisal by shadow pricing with case studies; Financial analysis; Budgeting; Toll system analysis.

UNIT–V:

Environmental Impact Assessment: Basic Concepts of EIA, objectives, transportation related environmental impacts – vehicular impacts – safety impacts – roadway impacts – construction impacts – environment audit; case studies.

TEXT BOOKS:

1. Transportation Engineering Economics, Heggie I. G., McGraw Hill
2. Economic Analysis for Highways, Winfrey R.
3. Traffic Engineering and Transport Planning, L. R. Kadiyali, Khanna Publishers

REFERENCES:

1. Road User Cost Study, CRRI
2. IRC: SP: 30-2019, Manual on Economic Evaluation of Highway Projects in India, IRC Publications, New Delhi
3. IRC: SP: 19; 2015, Manual for Survey, Investigation & Preparation of Road Projects, IRC Publications, New Delhi

ONLINE RESOURCES:

1. https://dspace.mit.edu/bitstream/handle/1721.1/107706/11-540j-fall 2006/contents/lecturenotes/index.htm
2. https://nptel.ac.in/courses/105/107/105107067

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PC1HW06) ADVANCED TRAFFIC ANALYSIS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To introduce students on the concepts of microscopic traffic parameters
- To analyze intersections using shockwave and bottleneck theories
- To identify the importance and types of pedestrian facilities
- To understand the importance of simulation

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Evaluate microscopic characteristics of traffic speed, flow and density.
CO-2: Analyze the intersections by understanding bottleneck and shock wave theory.
CO-3: Design pedestrian facilities based on their behavior and gap acceptance studies.
CO-4: Apply the concepts of simulation for solving real time traffic problems

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	1	3	-	-	-
CO-2	1	2	3	-	-	1
CO-3	-	2	3	2	-	1
CO-4	-	-	3	2	2	-

UNIT–I:
Traffic Flow Description: Traffic Stream Characteristics and Description Using Distributions; Measurement, Microscopic and Macroscopic Study of Traffic Stream Characteristics - Flow, Speed and Concentration; Distributions for Vehicle Arrivals, Headways, Speeds, Fitting of Distributions, Goodness of Fit Tests

UNIT–II:
Traffic Stream Models: Fundamental Equation of Traffic Flow; Speed-Flow-Concentration Relationships, Normalized Relationship, Fluid Flow Analogy Approach; Shock Wave Theory – Flow-Density diagram use in Shockwave analysis; Use of Time-space diagram for shockwave description; Bottleneck situations and shockwaves; Traffic signal and shockwave theory; Numerical examples for application of shockwave theory; Car-Following Theory

UNIT–III:
Queuing Theory: Fundamentals of Queuing Theory - Demand Service Characteristics-Deterministic Queuing Models - Stochastic Queuing Models - Multiple Service Channels,

UNIT–IV:

Queuing Analysis: Analysis of M/M/1 system; Assumptions and Derivation of System State Equations; Application of M/M/1 analysis for parking and Toll Plazas- Numerical Examples; Analysis of D/D/1 system for delay characteristics; Traffic Signal analysis as D/D/1 system; Computation of delays and queue dissipation Time – Numerical Examples.

UNIT–V:

Pedestrian Analysis and Simulation of Traffic: Pedestrian Gap acceptance and delays; Pedestrian Characteristics, Methods for measuring pedestrian effectiveness; Warrants for Pedestrian Crossing Facilities – Minimum Vehicular Volume Warrant, Minimum Pedestrian Volume Warrant, Maximum Pedestrian Volume Warrants, Introduction - Advantages of Simulation techniques; Steps in Simulation - Scanning techniques - Example of Simulation.

TEXT BOOKS:

1. Traffic Engineering and Transportation Planning, L. R. Kadiyali, Khanna Publishers
2. Fundamentals of Transportation Engineering, C. S. Papacostas, Prentice Hall India
3. Traffic Flow Theory: A Monograph, TRB Special Report 165

REFERENCES:

1. Principles of Highway Engineering and Traffic Analysis, F. L. Mannering & W. P. Kilareski, John Wiley
2. Traffic Flow Fundamentals, A. D. May, Prentice Hall India
3. Transport Planning and Traffic Engineering, Coleman A. O'flaherty, Butterworth Heinemann

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW09) HIGHWAY CONSTRUCTION PRACTICES

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To learn the various components of pavement structure
- To understand, Design and construct various drainage systems
- To gain knowledge on various equipment's used for road construction
- To understand various construction and maintenance techniques for pavement layers

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Recognize and select the Equipment's for the construction of road
CO-2: Explain the importance of drainage design in pavement layers
CO-3: Design and economize the construction of different layers such as base and sub-base course
CO-4: Identify the maintenance works required for various components of road

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	1	2	-	1	-
CO-2	2	2	2	-	1	-
CO-3	-	2	3	1	-	2
CO-4	2	2	3	-	2	3

UNIT–I:
Pavement Constructional Operation: Requirements and sequence of construction operation; plants and equipment for production of materials - crushers, mixers, bituminous mixing plants, cement concrete mixers – various types, advantages and choice.

UNIT–II:
Pavement Drainage Construction: Drainage materials, Construction of surface and subsurface drainage system including the filter materials for roads; and drainage system for urban road; Estimation of inflow, determination of drainage capacity

UNIT–III:
Road Construction Equipment: Different types of excavators, graders, soil compactors / rollers, pavers and other equipment for construction of different pavement layers – their uses and choice Problem on equipment usage charges.
Pre-construction surveys

Marking on ground - Specifications and steps for the construction of road formation in embankment and cut, construction steps for granular sub-base, quality control tests.

UNIT–IV:

Pavement Construction: Different types of granular base course – WMM, DBM; specifications, construction method and quality control tests. Different types of bituminous layers for binder and surface courses; their specifications (as per IRC and MORTH); construction method and quality control tests. Different types of sub-base and base course for cement concrete (CC) pavement and construction method. Construction of cement concrete (PQC) pavements joints quality control during construction.

UNIT–V:

Pavement Repairs: Preparation of existing pavement – patching, profile correction, Special measures to deal with reflection cracks in pavement layers, the slipperiness of the surface, etc. Special problems in construction & maintenance of hill roads, landslide, causes, investigation, and preventive and remedial measures, protection of embankments and cut slopes

TEXT BOOKS:

1. Construction Planning Equipment and Method, Peurifoy R. L., and Clifford J. S., McGraw Hill
2. Inc. Hot Mix Asphalt Materials, Mixture Design and Construction, Freddy L. Roberts, Prithvi S. Kandhal et al., 2nd Edition, National Asphalt Pavement Association Research and Education Foundation, Maryland, USA
3. Construction Equipment and its Management, Sharma S. C., Khanna Publishers

REFERENCES:

1. Hot Mix Asphalt Paving Hand book, National Asphalt Pavement Association, USA
2. MoRTH Manual for Construction and Supervision of Bituminous Works-2015, Indian Roads Congress
3. MoRTH Manual for Maintenance of Roads-2015, Indian Roads Congress

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW10) COMPUTATIONAL TECHNIQUES IN HIGHWAY ENGINEERING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand simulation techniques
- To evaluate simulation techniques
- To learn queuing theory for highway engineering
- To appreciate soft computing techniques

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Identify Simulation techniques
CO-2: Evaluate Simulation techniques
CO-3: Appraise Queuing Theory
CO-4: Relate Soft Computing Techniques for highways

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	-	-	-	2	-
CO-2	2	3	2	1	2	-
CO-3	1	1	3	-	-	2
CO-4	3	-	-	3	3	1

UNIT–I:
Modeling and Simulation:
Model Classification: Mathematical, Physical and Analog models. Steps involved in simulation, Monte Carlo Simulation, Model Validation and verification of simulation models. Continuous and Discrete Models, Model Calibration and Model Validation.

UNIT–II:
Sampling Techniques: Frequency distribution, mean, standard deviation, standard error, Skewness, Kurtosis, Definitions and applications; Simple random sampling, stratified sampling, systematic sampling, sample size determination, Applications in Traffic engineering;

UNIT–III:
Data Analysis Using Different Distributions: Binomial, Poisson, Exponential and Normal distributions; Fitting of distributions, Mean and variance, Chi-square test of goodness-of-fit, Chi-square distribution, Students T-distribution, Snedectors F-distribution.
Service Rate Analysis: General Structure, operating characteristics, deterministic queuing model, probabilistic queuing models and simulation of queuing systems.

UNIT–IV:

Multivariate Data Analysis: Vectors and Matrices, Simple estimate of centroid, standard deviation, dispersion, variance and co-variance, correlation matrices, **Principal Component Analysis, Forecasting Models:** Moving averages, exponential smoothening, trend projections, causal models, time series analysis of vehicle growth and road traffic crashes.

UNIT–V:

Soft Computing Techniques: Artificial Neural Networks – Basic concepts, neural architecture and examples. Support Vector Machines – Basic concepts, classification and support vector regression, concepts of kernels, basics of optimization programming.

TEXT BOOKS:

1. Multivariate Data Analysis, Hair J. and Anderson R.
2. Applied Multivariate Statistical Analysis, Johnson R. A. and Wichern D. W.
3. Support Vector Machines for Pattern Classification, S. Abe

REFERENCES:

1. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor K. V., Sultan Chand
2. Multivariate Data Analysis, Cootey W. W. & Cohens P. R, John Wiley
3. Probability Concepts in Engineering, Planning and Design, Vol. I & II, Alfredo H. S. Wilson H. Tang, Wiley International

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW11) NUMERICAL METHODS AND APPLIED STATISTICS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand various sampling techniques
- To gain Knowledge on Statistical distribution applications in traffic engineering
- To analyze data using correlation, probability and regression methods
- To perform and interpret the importance of statistical significance

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Apply sampling techniques knowledge in traffic street design
CO-2: Describe statistical distributions process and its application in traffic engineering
CO-3: Use fundamentals of probability and regression in road safety analysis
CO-4: Assess the Importance of statistical significance for design of traffic elements

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	2	-	2	1	-
CO-2	2	2	3	2	2	-
CO-3	-	2	1	2	2	-
CO-4	1	3	2	2	2	2

UNIT–I:
Introduction & Sampling Techniques: Frequency distribution; Mean; Standard deviation; Standard error, Skewness; Kurtosis; Definitions and Applications; Simple random sampling; Stratified sampling; Systematic sampling; Sample Size determination; Applications in Traffic Engineering,

UNIT–II:
Statistical Distributions: Binomial, Poisson, Exponential and Normal distributions; Fitting of distributions; Mean and variance; Chi-square test of goodness-of-fit; Applications in Traffic Engineering.

UNIT–III:
Probability: Laws of Probability; Conditional probability and independent events; Laws of expectation.
Regression and Correlation: Linear regression and correlation; Multiple correlation; Multiple correlation coefficient; Standard error of estimate; Analysis of Variance; Curvilinear regression; Applications in Transportation Engineering.

UNIT–IV:

Statistical Data Analysis: Basic vectors and matrices; Simple estimate of centroid, Standard deviation, Dispersion, Variance and covariance; Correlation matrices; Principal component analysis; Time series analysis.

Exact Sampling Distributions: Chi-square distribution; Students T-distribution; F-distribution.

UNIT - V

Tests of Significance & Confidence Interval: Large sample and small sample tests; Tests for single mean, Means of two samples, Proportions, two variances, two observed correlation coefficients, paired T-tests, Applications.

Intervals for mean, variance and regression coefficients; Applications in Traffic Engineering problems.

TEXT BOOKS:

1. Numerical Methods for Scientific and Engineering Computations, M. K. Jain, S. R. K. Iyengar and R. K. Jain., Wiley Eastern Limited
2. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor K. V. Sultan Chand
3. Introduction Methods of Numerical Analysis, S. S. Sastry, Prentice Hall of India
4. Applied Numerical Analysis, Gerald C. F. and Wheatley P. O., Addison-Wesley

REFERENCES:

1. Numerical Methods for Engineers with Personal Computer Applications, Charpa S. C. and Canale R. P., McGraw Hill
2. Probability Concepts in Engineering, Planning and Design, Vol. I & II, Alfredo H. S., Wilson H. Tang, Wiley International
3. Probability Statistics and Decision for Civil Engineers, Benjamin J. R. and Cornell C. A., McGraw Hill

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW12) ADVANCED HIGHWAY MATERIALS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To identify the properties of aggregate and bituminous materials
- To understand different composites and recycled waste products used in pavement constructions
- To comprehend the principles of bituminous pavement construction
- To learn the procedure for bituminous and PCC mix design

COURSE OUTCOMES: After completion of the course, the student should be able to
CO- 1: Understand the properties and test procedures of pavement materials
CO- 2: Evaluate the characteristics of mix design for modified bituminous mixtures
CO-3: Assess the performance of composites and recycled materials used in bituminous mixes
CO- 4: Explain different types of bituminous pavement construction

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	2	2	-	2	2
CO-2	2	2	3	2	2	-
CO-3	3	2	3	2	2	2
CO-4	2	-	3	-	-	2

Aggregate: Nature and properties – aggregate requirements – types and processing – aggregates for pavement base – aggregate for bituminous mixture – aggregate for Portland Cement Concrete – lightweight aggregate – tests on aggregate – specification.

UNIT–II:
Reclaimed / Recycled Waste Products: Reclaimed Materials – waste products in civil engineering applications – effect of waste products on materials, structure and properties – self healing and smart materials – locally available materials, IRC and AASHTO guidelines.

UNIT–III:
Cement / Concrete-Based Materials: Cement – properties – PCC mix design and properties – modified PCC – Mix Design – Behaviour – Performance – Tests on Cement and Concrete mixes. High Performance Concrete – low shrinkage – increased strength.

UNIT–IV:

Composites, Plastics: Plastics and polymerization process – properties – durability and chemical composition – Reinforced Polymer Composites

UNIT–V:

Geo-synthetics: Properties – durability and chemical composition – Geosynthetics – Dry Powdered Polymers – Enzymes.

TEXT BOOKS:

1. Alternative Materials in Road Construction, P. T. Sherwood, Thomas Telford Publication
2. Soil Mechanics for Road Engineers, RRL, DSIR, HMSO
3. Designing with Geosynthetics, Koerner R. M. Prentice Hall, Englewood Cliffs

REFERENCES:

1. Civil Engineering Materials, Shan Somayaji, 2nd Edition, Prentice Hall Inc.
2. Pavement Engineering – Principles and Practice, Mallick R. B. and T. El-Korchi, CRC Press, Taylor and Francis
3. Pavement Design and Materials, Papagiannakis A. T. and E. A. Masad, John Wiley & Sons

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW13) HIGHWAY PROJECTS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To prepare project report for new and up-gradation road type
- To conduct the soil and material investigations
- To perform various traffic studies for forecasting traffic data
- To understand the preparation of DPR on road projects and the tendering process

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Prepare project report for new and up-gradation of existing highways
CO-2: Conduct the soil and material investigations to understand the performance of pavement materials
CO-3: Perform various traffic related studies for project appraisal
CO-4: Development of DPR on road projects with relevant drawings

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	3	2	1	-	-
CO-2	1	2	3	-	2	-
CO-3	1	2	3	2	2	-
CO-4	-	3	-	-	-	3

UNIT–I:

Introduction: Various steps of preparation and execution of road projects, Investigations for preparation of project reports for new and up-gradation of roads. Objects and scope of pre – feasibility, feasibility and detailed studies for project preparation Topographic surveys and investigations for finalisation of horizontal alignment and vertical profile of roads.

UNIT–II:

Material Investigations: Soil investigations for assessing the design details of road embankments and cuts, drainage requirements and foundation of cross drainage structures; Material surveys and investigations for availability and choice of basic and alternate materials for road construction and for soil stabilization

UNIT–III:

Traffic Studies and Forecast: Classified traffic volume, growth rate, projected traffic for assessing road way requirements, origin- destination characteristics and studies, Axle load / wheel load studies using weigh bridges and analysis of data for pavement

design; Traffic forecast - traffic growth estimation from past trends, econometric models. Common methods of traffic forecast

UNIT–IV:

Environmental Assessment: Environmental and social impact studies and assessment relevant to road up-gradation / new projects, Mitigation measures, Road safety audit. Collection of relevant data, analysis and interpretation for pre-feasibility and feasibility study reports of the proposed road project. Economic evaluation of different possible alternatives. Preparation of drawings and project reports. Use of software

UNIT–V:

Project Report Preparation: Preparation of DPR design details, estimates, BOQ, drawings and detailed project report, use of software Tendering process - Preparation of tender documents for different types of road projects, tender evaluation.

TEXT BOOKS:

1. Principles of Pavement Design, Yoder E. J., and Witczak, 2nd Edition, John Wiley and Sons
2. The Design and Performance of Road Pavements, Croney D. and P. Croney, McGraw-Hill

REFERENCES:

1. IRC: SP:19 - 2020, Manual for Survey, Investigation and Preparation of Road Projects - (First Revision), Indian Roads Congress
2. IRC: SP: 30 - 2019, Manual on Economic Evaluation of Highway- Projects in India (First Revision), Indian Roads Congress
3. IRC SP – 38, Manual for Road Investment Decision Model-1992, Indian Roads Congress
4. MoRTH, Specifications for Road Bridge Works- 2015, Fifth Revision, Indian Roads Congress

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW14) PAVEMENT MANAGEMENT SYSTEMS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand network level and project level PMS
- To evaluate pavement on functional and structural basis
- To learn alternative design strategies of pavements for economic evaluation
- To appreciate the role of expert system in PMS

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Identify the pavement design strategies using PMS Concept
CO-2: Evaluate the pavement condition using functional and structural evaluation techniques
CO-3: Appraise and estimate the life cycle cost of Pavement
CO-4: Apply ANN and Fuzzy techniques for PMS

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	-	3	-	-	-
CO-2	1	-	3	-	-	2
CO-3	2	3	2	2	2	-
CO-4	2	2	2	3	3	-

UNIT–I:
Introduction to PMS: Need of PMS, pavement distress in flexible and rigid pavement. Definition -Components of Pavement Management Systems, Essential features Pavement Management Levels and functions: Ideal PMS- at Network and Project levels of PMS.

UNIT–II:
Pavement Performance: Serviceability Concepts- roughness- Roughness Components Equipment -IRI -modelling techniques, Ranking and Optimization Methodologies: Recent developments, sample size selection, economic optimization of pavement maintenance and rehabilitation.

UNIT–III:
Functional & Structural Evaluation: Functional and Structural Distress Modes – Cracking Rutting and Structural conditions deterioration models, unevenness prediction models and other models, comparison. Pavement Deflection - Different Methods.

UNIT–IV:

Design Alternatives and Selection: Design objectives and constraints, alternate pavement design strategies, Mechanistic and empirical models, and other models, life cycle costing, analysis of alternate pavement strategies based on distress and performance, case studies. Equipment's.

Pavement Rehabilitation: Rigid pavement rehabilitation, flexible pavement rehabilitation, alternative and condition survey for rehabilitation.

UNIT–V:

Expert Systems and Pavement Management: Role of computers in pavement management, applications of expert systems for managing pavements, knowledge-based expert systems. HDM, RTIM Packages, other models, comparison of different deterioration models. Highway Financing, Fund Generation, Evaluating Alternate Strategies and Decision Criteria.

TEXT BOOKS:

1. Pavement Management System, Ralph Haas and Ronald W. Hudson, McGraw Hill
2. Modern Pavement Management, Haas R., W. R. Hudson and J. P. Zaniewski, Krieger Publishing Company
3. Pavement Management for Airports, Roads, and Parking Lots, M. Y. Shahin, 2nd Edition, Springer

REFERENCES:

1. Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation, Hudson W. R., R. Haas and Waheed Uddin McGraw Hill
2. Proceedings of International Conference on Structural Design of Asphalt Pavements
3. NCHRP, TRR and TRB Special Reports
4. Pavement Analysis and Design, Huang Yang H., Prentice-Hall

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW15) HIGHWAY NETWORK ANALYSIS AND OPTIMIZATION TECHNIQUES

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand different traffic assignment techniques
- To apply appropriate methods to design transportation networks
- To learn different optimization techniques
- To analyze multi criteria optimization

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Apply different traffic assignment techniques
CO-2: Design transportation networks
CO-3: Differentiate various optimization techniques for the transport network
CO-4: Analyze multi criteria optimization for optimality

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	2	2	2	-	2
CO-2	2	-	3	2	2	1
CO-3	2	-	2	2	-	-
CO-4	3	2	3	3	2	2

UNIT-I:
Basics of Transportation Networks: Networks representation, Network equilibrium, Link and Cost Functions, Incidence matrices, Network capacity, shortest path algorithm.

UNIT-II:
Assignment Techniques: User Equilibrium – Existence and Uniqueness, Deterministic user equilibrium assignment, Most Likely paths, Elastic demand, Time-Dependent Networks, stochastic user equilibrium assignment, User Equilibrium with variable demand models, Space-time networks, Maximum entropy, Generalized least squares, Linear path-flow estimations, Log-linear path flow estimations, Case Studies.

UNIT-III:
Network Design: Bi-level programming-Iterative design, Sensitivity based algorithm, Sensitivity of user equilibrium, and stochastic user equilibrium methods. Combined trip distribution and assignment, Combined mode choice, assignment, discrete choice models, Application to route choice, Estimating OD matrices, Estimating demand functions, Theory of congestion pricing, Path flows, link flows, Path-based and origin-based methods.

UNIT-IV:

Basics of Optimization: General methods for operation research models; introduction to linear and non-linear programming formulation of different models, formulation of linear programming problems, graphical solution method, alternative or multiple optimal solutions, unbounded solutions, infeasible solutions, maximization – simplex algorithms.

UNIT-V:

Mathematical Optimization: Optimality criteria for the Unconstrained Problems, Optimality Criteria for the Constrained Problems, Optimality Criteria for General Optimization Problems, Post optimality Analysis; Mult criteria Optimization, Optimization on Fuzzy Sets.

TEXT BOOKS:

1. Transportation Network Analysis, Michael G. H., Bell and Yasunori Lida, John Wiley
2. Urban Transportation Networks: Equilibrium Analysis with Mathematical Programming Methods, Yosef Sheffi, Prentice Hall
3. Engineering Optimization Theory and Practice, Rao S. S., Wiley

REFERENCES:

1. Network Flows, Ravindra K Ahuja, Thomas L Magnanti, Creative Media Partners, LLC
2. Transportation and Network Analysis: Current Trends: Miscellanea in Honor of Michael Florian, Michael Alexander Florian, Michel Gendreau, Patrice Marcotte, Springer Publisher
3. Introduction to Optimum Design, Arora, J.S., McGraw Hill International Editions,
4. Mathematical Methods on Optimization in Transportation Systems, Pursula, M., Niittymäki, J.
5. Transportation Systems Analysis: Models and Applications, Cascetta, E.,

ONLINE RESOURCES:

1. https://transportgeography.org/contents/chapter2/geography-of-transportation-networks/
2. https://nptel.ac.in/courses/112/106/112106134/#
3. http://web.mit.edu/sheffi/www/selectedMedia/sheffi_urban_trans_networks

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW16) PAVEMENT EVALUATION AND REHABILITATION

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To learn the importance of evaluation and strengthening of pavements
- To explain the stress and strains for various types of pavements and its evaluation procedures
- To categorize the pavement rehabilitation methods
- To understand overlay design concepts performed through BBD and FWD

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Assess the functional and structural failures of pavements

CO-2: Understand different types of distresses in pavements

CO-3: Identify different pavement rehabilitation techniques

CO-4: Perform BBD and FWD tests for pavement evaluation

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	1	3	-	-	-
CO-2	2	-	3	2	-	-
CO-3	2	2	2	-	-	-
CO-4	-	2	3	-	2	2

UNIT–I:

Functional Evaluation of Pavements: Importance of pavement evaluation, functional condition evaluation techniques, network, project level, roughness measurement methods, Identification of uniform sections, serviceability concepts, visual and rating procedures, data collection technologies, pavement deterioration, factors affecting pavement deterioration, modelling, and comparison of different deterioration models.

UNIT–II:

Structural Evaluation of Pavements: Structural condition evaluation, static, semi-static, moving deflection measuring devices, rebound deflection, deflection bowl measurement and analysis, AASHTO AND IRC overlay design method, back-calculation of layer moduli, ground-penetrating radar evaluation of pavement safety: skid resistance, mobile devices measuring skid resistance and hydroplaning.

UNIT–III:

Pavement Rehabilitation: Introduction, benefits of recycling, methods, recycling strategies, cold milling, ripping, crushing, recycling batch plant, drum mix plant, mix

design, in-place recycling techniques, cold in-place recycling, full-depth reclamation, and current practices for improving riding quality.

UNIT–IV:

Pavement Maintenance: Surface distresses, types, causes and redial measures, types of maintenance, classification of maintenance activities, pavement maintenance norms maintenance, development of decision tree, decision matrix, selection of treatment strategies, local, global maintenance and rehabilitation strategies, HDM-4 applications, and life cycle cost analysis.

UNIT–V:

Highway Maintenance: Need of Highway maintenance, methods of maintenance for flexible and rigid pavement layers; WBM, Bituminous and Cement Concrete pavements.

TEXT BOOKS:

1. Bituminous Road Construction in India, Kandhal P. S., PHI Learning
2. Pavement Management for Airport, Roads and Parking Lots, Shahin M. Y.
3. The Design and Performance of Road Pavements, Croney D., and P. Croney., McGraw Hill.

REFERENCES:

1. Pavement Management System, Haas and Hudson, McGraw Hill Book
2. Pavement Design and Materials, Papagiannakis A. T. and E. A. Masad, John Wiley
3. Pavement Engineering – Principles and Practice, Mallick R. B. and T. El-Korchi, CRC Press, Taylor and Francis

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW17) SUSTAINABLE TRANSPORTATION

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand the problem of sustainability
- To comprehend various sustainable mode choice facilities
- To plan and design different non-motorized transportation facilities
- To learn the policies of sustainable transportation development

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Identify a sustainable transportation system
CO-2: Consider sustainability in providing mode choices for the public
CO-3: Develop and plan pedestrian and bicycle facilities for sustainable transportation
CO-4: Suggest policies that improve sustainability of transportation

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	-	-	-	-	3
CO-2	2	2	3	2	2	1
CO-3	2	-	3	2	1	-
CO-4	2	2	-	2	-	2

UNIT–I:
Problem of Sustainability in Transport: Energy use in the transport sector; Transport and climate change; Greenhouse gas emissions, urban air quality, Congestion, and sustainability, Sustainable Development Goals.

UNIT–II:
Planning for Sustainability: Urban form, Indicator based planning, land use transport integration, Compact City, Public Transit, TOD, NMT, First and Last Mile Connectivity.

UNIT–III:
Non-Motorized Transportation Planning: Surveys, Demand Estimation and Analysis; Cycling Condition Evaluation Techniques; Pedestrian Condition Evaluation Techniques; Planning for Pedestrians- Types of pedestrians and Characteristics; Pedestrian facilities and planning; Pedestrian standards and improvements; Pedestrian facility Design, Planning for Bicyclists- Types of cyclists and Bikeways; Integrating cycling into roadway planning; Bicycle network planning; Design of Bicycle boulevards/bike paths; Bicycle Parking/storage Facilities; Roadway maintenance for cyclists.

UNIT–IV:

Sustainable Policies: Continuum of Policies, speed and speed limit policies, national policies, sustainable travel demand management; public awareness; pricing transportation: total cost of transportation, pricing, and taxation.

UNIT–V:

Sustainable Development: Telecommuting, Information and Communication Technologies, E-commerce, Alternative Cleaner Fuels, vehicle technologies, fuel cells, Intelligent Transport Systems, Mobility Management policies, Supporting Bicycling, creating pedestrian-friendly facilities, encouraging Public Transportation.

TEXT BOOKS:

1. An Introduction to Sustainable Transportation: Policy, Planning and Implementation, Preston L. Schiller, Eric C. Brunn, and Jeffrey R. Kenworthy, Routledge
2. Sustainable Transport: Planning for Walking and Cycling in Urban Environments, Rodney Tolley (Editor), CRC Press
3. Sustainable Transport: Problems and Solutions, Black W. R., Guilford Press

REFERENCES:

1. Accessible Cities and Regions: A Framework for Sustainable Transport and Urbanism in the 21st Century, Cervero R., Center for Future Urban Transport, Institute of Transportation Studies, University of California, Berkeley
2. Sustainable Transport: Definitions and Responses, In Transportation Research Board, Integrating Sustainability into the Transportation Planning Process, Conference Proceedings 37, Black W. R., National Research Council, Washington, DC
3. Transportation Technologies for Sustainability, Mehrdad Ehsani, Fei-Yue Wang and Gary L. Brosch (Eds.), Springer-Verlag

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ce74/preview
2. https://www.cutr.usf.edu/workforce/education/sustainable-transportation-course/

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PE1HW18) ROAD ASSET MANAGEMENT

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand different asset management techniques
- To apply appropriate methods for financial management
- To learn different construction and safety management techniques
- To analyze criteria for highway maintenance management systems

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand the principles and concepts of asset management
CO-2: Develop financial management and workforce management systems.
CO-3: Apply the construction and safety management techniques for highways
CO-4: Analyze the highway maintenance management systems

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	-	3	-	1	-
CO-2	2	2	-	2	-	2
CO-3	2	2	-	-	-	2
CO-4	3	2	3	-	2	2

UNIT-I:

Highway Asset Management: Principles, types of asset management definition, structure, historical background, elements of highway asset management, asset Inventory, activity and cost model development, public assets versus private assets, motivation for asset management, benefits of road asset, management system, financial management systems, roads billing, roads payment and cost accounting and tools for asset management.

UNIT-II:

Highway Asset Valuation and Frame Work: Asset Valuation approaches, guidelines, an overview of highway asset valuation procedure, valuation principles, basis and rules, depreciation, highway lighting, and high mast lighting, land associated with the highways

UNIT-III:

Construction Management Systems: Preconstruction scheduling, utility management, ROW management, user occupancy permits, project control, agreement monitoring, and contractor management.

UNIT-IV:

Roadway Operations Management Systems: Joint operations center, district operations center, traveler information systems.

UNIT-V:

Road Asset Management Modules: Bridge inventory and rating, bridge management; Workforce Management Systems: Payroll detail, personal information, and employee accident; Safety Management Systems: Accident records, hazardous location, and highway safety information; Equipment Management Systems: Equipment management information, fleet management.

TEXT BOOKS:

1. Transportation Asset Management Methodology and Application, Zongzhi Li, CRC Press
2. Pavement Management for Airport, Roads and Parking Lots, Shahin M. Y., Springer

REFERENCES:

1. Guidelines for Road Asset Management, IRC:130, Indian Roads Congress, New Delhi
2. Modern Pavement Management, Haas R., W. R. Hudson, and J. P. Zaniewski, Krieger Publishing Company
3. Performance Measures and Targets for Transportation Asset Management, NCHRP Report 551, TRB, Washington DC

ONLINE RESOURCES:

1. https://road-asset.piarc.org/en/management-performance-management/references http://www.fhwa.dot.gov/asset/pubs/hif13047.pdf
2. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_551.pdf
3. http://www.orams.in/

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PC2HW03) HIGHWAY MATERIAL CHARACTERIZATION AND TRAFFIC SIMULATION LABORATORY

TEACHING SCHEME		
L	T/P	C
0	2	1

EVALUATION SCHEME					
D-D	PE	LR	CP	SEE	TOTAL
10	10	10	10	60	100

COURSE OBJECTIVES:

- To understand and apply basic concepts for pavement evaluation techniques
- To learn binder performance characteristics
- To design and assess the performance characteristics of bituminous mixes
- To plan, develop un-signalised and signalised intersections using simulation techniques

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Identify different pavement evaluation techniques
CO-2: Perform various performance tests on binder
CO-3: Conduct performance tests on bituminous mixes
CO-4: Evaluate the performance of signalized and un signalized intersections using simulation techniques.

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	2	3	-	2	
CO-2	2	3	2	2	2	1
CO-3	2	3	3	-	2	2
CO-4	2	3	3	2	2	-

LIST OF EXPERIMENTS:

Tests on Functional & Structural Characteristics Pavement:

a) Road Roughness survey – MERLIN
b) Pavement evaluation using DCP, PLWD & BBD Techniques
c) Aggregate Polishing Value and Skid Resistance

Bitumen & Bituminous Mix Performance:

a) Kinematic viscosity using Rotational Viscometer
b) Short Term Ageing using RTFO
c) SARA fractions
d) Resilient Modulus for Bituminous Mixes
e) Rutting and Stripping Characteristics for Bituminous Mixes
f) Fracture properties of bituminous mixes – Semi Circular Bending test

Traffic Simulation: Simulation analysis for controlled & uncontrolled intersection using VISSIM.

REFERENCES:

1. Highway Materials And Pavement Testing, Khanna S. K., Justo C. E. G., and A. Veeraragavan, Nem Chand and Brothers, Roorkee
2. Pavement Analysis and Design, Huang Y. H., Pearson Prentice Hall
3. Relevant IS, IRC, ASTM Codes

Note: All laboratory tests are as per IS, ASTM, AASHTO, TRL, IRC, BS procedures / specifications and guidelines

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PC2HW04) HIGHWAY NUMERICAL ANALYSIS LABORATORY

TEACHING SCHEME		
L	T/P	C
0	2	1

EVALUATION SCHEME					
D-D	PE	LR	CP	SEE	TOTAL
10	10	10	10	60	100

COURSE OBJECTIVES:

- To understand the introduction of sampling techniques
- To knowledge on statistical distributions application in traffic engineering
- To learn probability and regression, data analysis and correlation techniques for road safety
- To perform different statistical measures for assessing model significance

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Apply sampling techniques in traffic stream design

CO-2: Relate statistical distributions process and its application in traffic engineering

CO-3: Analyze road safety using probability and regression techniques

CO-4: Understand statistical significance for design of traffic stream elements

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	-	-	1	-
CO-2	1	-	3	2	-	1
CO-3	1	-	3	2	2	-
CO-4	-	2	3	-	2	-

LIST OF EXPERIMENTS:

1. Random Numerical Sampling.
2. Fitting Binomial, Normal and Poisson distribution.
3. Time Series Analysis and Traffic Forecasting as per IRC 108 – 1996
4. Road Traffic Crashes with Geometrical Parameter and Skid Relationships
5. Multivariate Data Analysis
6. Linear and Generalized Models Calibration
7. Analysis of Noise/Air pollution related Transport Problems
8. Validation and Determining Goodness of Fit, Chi-Square, T-Tests and Other Measures of Fit.
9. Application of Soft Computing Techniques like Artificial Neural Network and Support Vector Machines to Transportation Problems using R software.
10. Basics of Transportation Software's (Demo) – Mx Road and QGIS.

TEXT BOOKS:

1. Multivariate Data Analysis, Hair J. and Anderson R.

2. Applied Multivariate Statistical Analysis, Johnson R. A. and Wichern D. W.
3. Support Vector Machines for Pattern Classification, S. Abe

REFERENCES:

1. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor K. V. Sultan Chand
2. Multivariate Data Analysis, Cootey W. W. & Cohens P. R., John Wiley
3. Probability Concepts in Engineering, Planning and Design, Vol. I & II, Alfredo H. S. Wilson H. Tang, Wiley International

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22PW4HW02) MINI-PROJECT

TEACHING SCHEME

L	T/P	C
0	4	2

CIE	SEE	TOTAL
40	60	100

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Understand the formulated industry / technical / societal problems
CO-2: Analyze and / or develop models for providing solution to industry / technical / societal problems
CO-3: Interpret and arrive at conclusions from the project carried out
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- A student shall undergo a mini-project during II semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on an allotted project topic of his / her choice, critically review the literature, carry out the project work, submit it to the department in a prescribed report form and shall make an oral presentation before the departmental Project Review Committee.
- Evaluation of the mini-project shall consist of CIE and SEE and shall be done by a Project Review Committee (PRC) consisting of the Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- CIE shall be carried out for 40 marks on the basis of review presentation as per the calendar dates and evaluation format.
- SEE shall be carried out at the end of semester fpr 60 marks on the basis of oral presentation and submission of mini-project report.
- Prior to the submission of mini-project report to the PRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The mini-project report shall be accepted for submission to the PRC only upon meeting the prescribed similarity index of less than 25%.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester

(22MN6HS02) ANCIENT WISDOM

TEACHING SCHEME

L	T/P	C
2	0	0

EVALUATION SCHEME

SE-I	SE-II	SEE	TOTAL
50	50	-	100

COURSE OBJECTIVES:

- To introduce the contribution from Ancient Indian system & tradition to modern science & Technology
- To trace, identify and develop the ancient knowledge systems
- To introduce the sense of responsibility, duties and participation of individual for establishment of fearless society

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Familiarize learners with major sequential development in Indian science, engineering and technology

CO-2: Understand eco-friendly, robust and scientific planning and architecture system of ancient India

CO-3: Trace, identify, practice and develop the significant Indian mathematic and astronomical knowledge

CO-4: Understand the importance of Indian aesthetics in individual realization of the truth arises by realizing the harmony within

UNIT-I:

Indian Science & Technology: Indian S & T Heritage, sixty-four art forms and occupational skills (64 Kalas)

Ancient Architecture:

Scientific Achievements though Ancient Architect: Musical Pillars of Vitthal temple, Sundial of konark temple, construction of eight shiva temple in straight line from Kedarnath to rameshwaram at longitude 79oE 41'54, Veerbhadra temple with 70 hanging pillars

UNIT-II:

Foundation Concept for Science and Technology: The Introduction to Ancient Mathematics & Astronomy Introduction to Brief introduction of inception of Mathematics & Astronomy from vedic periods. Details of different authors who has given mathematical & astronomical sutra (e.g. arytabhatta, bhaskara, brahmagupta, varamahira, budhyana, yajanvlkya, panini, pingala, 22 bharat muni, sripati, mahaviracharya, madhava, Nilakantha somyaji, jyeshthadeva, bhaskara-II, shridhara Number System and Units of Measurement, concept of zero and its importance, Large numbers & their representation, Place Value of Numerals, Decimal System, Measurements for time, distance and weight, Unique approaches to represent numbers (Bhūta Saṃkhya System, Kaṭapayādi System), Pingala and the Binary system, Knowledge Pyramid

Indian Mathematics, Great Mathematicians and their contributions, Arithmetic Operations, Geometry (Sulba Sutras, Aryabhatiya-bhasya), value of π, Trigonometry, Algebra, Chandah Sastra of Pingala, Indian Astronomy, celestial coordinate system,

Elements of the Indian Calendar Aryabhatiya and the Siddhantic Tradition Pancanga – The Indian Calendar System

UNIT-III:

Humanities & Social Sciences: Health, Wellness & Psychology, Ayurveda Sleep and Food, Role of water in wellbeing Yoga way of life Indian approach to Psychology, the Triguṇa System Body-Mind-IntellectConsciousness Complex. Governance, Public Administration & Management reference to ramayana, Artha Sastra, Kauṭilyan State

UNIT-IV:

Aspiration and Purpose of Individual and Human Society: Aims of Human life; at individual level and societal level. At societal level; Four purusarthas Dharma, Artha, Kama, Moksha.

Individual Level:

Program for Ensuring Human Purpose:

Fundamental Concept of Nitishastra: Satyanishtha Aur Abhiruchi (Ethics, Integrity & aptitude). The true nature of self; Shiksha Valli, Bhrigu Valli (concept of Atman-Brahman (self, soul).

The True Constitution of Human: Ananda Valli (Annamaya Kosha, Pranamaya Kosha, Manomaya Kosha, Vijnanamaya Kosha, Anandamaya Kosha). The four states of consciousness (Waking state, Dreaming state, Deep Sleep State, Turiya the fourth state), Consciousness (seven limbs and nineteen mouths), Prajna, Awarness. The Life Force Prana (Praana-Apaana-Vyaana-Udaana- Samaana

Ancient Indian Science (Ayurveda & Yoga)

Ayurveda for Life, Health and Well-being: Introduction to Ayurveda: understanding Human body and Pancha maha bhuta, the communication between body & mind, health

Introduction to Yoga: Definition, Meaning and objectives of Yoga, Relevance of yoga in modern age. the six cleansing procedures of Yoga, understanding of Indian psychological concept, consciousness, tridosha & triguna.

UNIT-V:

Five Important Slokas for Enlightenment

Gayatri Mantram, Santi Mantram: Asatoma Sadgamaya, Geeta (Yada Yadahi Dharmasya, Glanirbhavati Bharata), Amanitwam Adambitwam.., Karmanyevadikarastu… Maa phaleshukadachana

TEXT BOOKS:

1. Textbook on Indian Knowledge Systems, Prof. B Mahadevan, IIM Bengaluru
2. Indian Knowledge Systems, Kapur K. and Singh A. K., 2005

REFERENCES:

1. Tatvabodh of Sankaracharya, Central Chinmay Mission Trust, Bombay, 1995
2. Value and Distribution System in India, B. L. Gupta, Gyan Publication House
3. Ancient Indian Culture and Civilization, Reshmi Ramdhoni, Star Publication, 2018
4. Ancient Indian Society, Maharaj Swami Chidatmanjee, Anmol Publication
5. Ancient Indian Classical Music, Lalita Ramkrishna, Shubhi Publications

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22PE1HW19) RURAL ROAD ENGINEERING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To plan the rural road network with geometry
- To explain the approaches considered for Rural Road
- To design low volume roads
- To understand rural road quality control and maintenance

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Design and plan rural road network geometry
CO-2: Understand the pavement materials used in rural road constructions
CO-3: Design pavement for low volume roads
CO-4: Comprehend measures for rural road quality control and maintenance

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	-	3	-	2	-
CO-2	-	2	3	2	-	-
CO-3	2	-	3	-	2	2
CO-4	2	3	3	2	2	2

UNIT-I:
Planning of Low Volume Roads: Introduction to planning of low volume roads, concepts of network planning, selection of roadway alignment, factors affecting rout selection, engineering surveys for new road location.

UNIT-II:
Geometric Design Parameters: basic principles of geometric design, design of horizontal alignment, curves, super elevation, design of vertical alignment, summit curve, and vally curve standard of design of low volume road.

UNIT-III:
Materials and Specifications: Specifications and Road materials for pavement construction, soil-subgrade, road aggregate, binder, test on soil, test on aggregates and test on bitumen, bituminous mix design, marshal stability method for mix design. Introduction to advance material and innovative technologies in low Volume roads.

UNIT-IV:
Design of Pavement: Factors affecting pavement design function of pavement components, design of flexible pavement by GI method, CBR method, burmister

layer. Fly ash for road construction, design & construction, design &construction of fly ash embankment lime fly ash and stabilized soil, lime fly ash pavements, control of compaction, concrete stabilized fly ash with admixtures. Design of rigid pavement by using IRC method.

UNIT-V:

Quality Control and Maintenance: Introduction, Pre-requirements, organizational setup, specification, and code of practice, Laboratory equipment, Earth and granular layers, bituminous courses, semi- rigid and rigid pavements, special requirements, recovered of quality control data. Distresses/Defects in rigid and flexible pavements, Maintenance and evaluation, inventory roads and inspections, types of Maintenance Activities, Maintenance

TEXT BOOKS:

1. Highway Engineering, A. Veeraragavan, S. K. Khanna and C. E. G. Justo, Nem Chand & Brothers, 2014
2. Pavement Analysis and Design, Yan H. Huang, 2nd Edition, Prentice Hall, 2004
3. IRC SP 72-2015 Rural road manual, Indian Road Congress, New Delhi, 2002

REFERENCES:

1. Ministry of Rural Roads, Specifications for Rural Roads, Indian Roads Congress, New Delhi, 2014
2. Low-Volume Roads Engineering: Best Management Practices – Field Guide, Gordon Keller & James Sherar, USDA Forest Service/USAID, 2003. 27
3. NRRDA – Guidelines and Code Books

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22PE1HW20) ARTIFICIAL INTELLIGENCE APPLICATIONS IN TRANSPORTATION ENGINEERING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To comprehend the fundamental concepts of artificial intelligence and machine learning
- To explore various AI methods used in transportation
- To analyze various applications of AI in transportation
- To enumerate the use of AI in transportation planning

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Comprehend the fundamental concepts of artificial intelligence and machine learning.
CO-2: Explore and apply various AI methods used to solve transportation problems.
CO-3: Analyze various applications of AI in transportation.
CO-4: Enumerate the use of AI in transportation planning

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	2	-	2	2	-
CO-2	2	2	3	2	2	-
CO-3	3	-	3	3	2	2
CO-4	2	-	3	2	2	2

UNIT-I:
Fundamentals of Artificial Intelligence: AI and problem solving - problem solving as state space search-uniformed search, Problem solving by search- heuristic search-informed search-constraint satisfaction problems, Knowledge representation and reasoning, reasoning under uncertainty-Bayesian network – decision network, planning and decision making.

UNIT-II:
Introduction to Machine Learning: Learning decision trees, linear regression, Support Vector machine, supervised learning, unsupervised learning, reinforcement learning, learning in neural networks, Deep learning- a brief overview.

UNIT-III:
AI Methods in Transportation: Artificial Neural Networks (ANN), Genetic algorithms (GA), Simulated Annealing (SA), Artificial Immune system (AIS), Ant Colony Optimiser (ACO)- Bee Colony Optimization (BCO) and Fuzzy Logic Model (FLM)

UNIT-IV:

AI Applications in Transportation: Self-driving vehicles, traffic detection and traffic signs, pedestrian detection, traffic flow analysis, computer vision-powered parking management, road condition monitoring, automatic traffic incident detection, automated license plate recognition, driver monitoring, public transportation, auto urban mobility, traffic management.

UNIT-V:

AI in Planning, Designing and Controlling Transport Network Structure: Network Design Problem (NDP), Bi non-linear model assignment, Safety management plan, best path identification- real time path generation system-utility based approach, integration of AI and ITS, predictive models.

TEXT BOOKS:

1. Artificial Intelligence, Patrick Henry Winston, 3rd Edition, Addison-Wesley, 2004
2. Principles of Artificial Intelligence, Nils J. Nilsson, Illustrated Reprint Edition, Springer Heidelberg, 2014
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, PHI 2009

REFERENCES:

1. Quest for Artificial Intelligence, Nils J. Nilsson, 1st Edition, Cambridge University Press, 2010

2. Applications of Artificial Intelligence in Transport: An Overview, Abduljabbar R., Dia H., Liyanage S., Bagloee S. A., *Sustainability,* 2019 https://doi.org/10.3390/su11010189

ONLINE RESOURCES:

1. https://www.datatrained.com/post/artificial-intelligence-syllabus/
2. https://onlinecourses.nptel.ac.in/noc21_ge20/preview

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22PE1HW21) ADVANCED TRAVEL DEMAND MODELLING

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To estimate the qualitative variables and develop discrete choice models
- To assess the travel demand using stated preference data
- To estimate travel demand using activity-based modelling
- To evaluate the model's aggregation and transferability

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Estimate the travel demand using discrete choice models, stated preference methods and activity-based analysis
CO-2: Assess the qualitative variables
CO-3: Evaluate the models aggregation and transferability
CO-4: Comprehend the advanced travel demand modelling techniques

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	2	3	-	-	1
CO-2	2	2	3	2	-	1
CO-3	2	2	3	3	2	2
CO-4	3	-	3	-	3	-

UNIT-I:
Discrete Choice Analysis and Stated Preference Methods: Utility Concept; Mode choice; Logit Models; Dogit Model; Nested Logit Model; Probit Model; Route Choice Modelling; Combined Travel Demand Modelling; Model Parameter Estimation – Maximum Likelihood and Maximum Entropy Estimates, Stated preference vs. Revealed Preferences; Design Issues; Survey Methods, Conjoint Analysis; Functional Measurement; Trade-off Analysis, Transfer Price Method

UNIT-II:
Activity-Based Travel Demand Models: Activity patterns; Activity scheduling; Activity Time Allocation studies; Activity Episode Analysis; Travel Duration Analysis

UNIT-III:
Qualitative Variables: Role of Soft variables in Travel Demand Forecasting; Attitudes; Psychometric scaling Techniques – One-dimensional Scaling – Multidimensional Scaling; Basic Rating Scales: Comparative Rating Scales, Non – Comparative Rating scale, Itemised rating scale, graphic rating scale; Specific Attitude scales; Successive Categories; Principal Components Factor Analysis; Attitudinal Models.

UNIT-IV:

Model Aggregation and Model Transferability: Aggregation bias and forecasting; Aggregation Methods; Temporal Stability and geographical stability of Models; Transfer Model Updating Procedures – Transferring with Aggregate and Disaggregate sample data; Transferability Measures

UNIT-V:

Introduction to Advanced Modelling Techniques: Sketch planning Methods; Incremental Demand Models; Model estimation from traffic Counts; IVF Models, Marginal and Corridor Models; Gaming Simulation, Quick Response Techniques, GO Models; Entropy Models; Equilibrium Assignment Techniques, Multipath Assignment – Dial's Algorithm, Knowledge-Based Expert System; Neuro-Fuzzy Application; ANN Techniques; Genetic Algorithms; Object-Oriented Programming; Decision Support Systems; Goal Programming.

TEXT BOOKS:

1. Modelling Transport, Ortuzar J de D. and L. G. Willumsen, 4th Edition, John Wiley, 2011
2. Activity-Based Travel Demand Models: A Primer, Joe Castiglione, Mark Bradley, and John Gliebe, TRB, Washington, 2015
3. Urban Travel Demand Modelling: From Individual Choices to General Equilibrium, Oppenheim N., John Wiley and Sons, 1995

REFERENCES:

1. Discrete Choice Analysis: Theory and Application to Travel Demand, Moshe Ben-Akiva, Steven R. Lerman, MIT Press, 2018
2. Discrete Choice Modelling and Air Travel Demand: Theory and Applications, Laurie A. Garrow, Routledge, 2010
3. Optimization in Location and Transport Analysis, Alan Geoffrey Wilson, John Wiley & Sons, 1981
4. Progress in Activity-Based Analysis, Harry Timmermans, Elsevier Science, 2005.
5. Time use Analysis, Special Issue, Transportation, 26, Kluwer Academic Publishers, 1999

ONLINE RESOURCES:

1. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_C46.pdf 2.
2. https://www.nap.edu/download/13678

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22PE1HW22) TRAFFIC FLOW MODELLING AND SIMULATION

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand the behaviors of Traffic flow modelling
- To learn and implement various techniques of pedestrian flow modelling
- To gain the knowledge on concept of queuing
- To simulate the models of traffic flow

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Distinguish methods of traffic flow modelling
CO-2: Explore pedestrian stream models
CO-3: Analyse shock waves and queuing patterns
CO-4: Develop and validate traffic simulation models

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	3	2	1	-	2
CO-2	3	3	2	2	-	2
CO-3	3	3	1	-	-	2
CO-4	3	2	1	-	3	2

UNIT-I:
Traffic Flow Modelling: Basic concepts, time-dependent and independent models, advanced macroscopic models, microscopic models modeling approach, lane changing models-T curves, gap acceptance models, inhomogeneous highway, moving bottlenecks, LWR models and its extension, car-following models, traffic based probabilistic and stochastic models.

UNIT-II:
Pedestrian Flow Modeling: Pedestrian behaviour-based modelling, pedestrian behavioural models, pedestrian interactions models, microscopic and macroscopic models, pedestrian simulation concepts, pedestrian stream model examples.

UNIT-III:
Shockwave Analysis: Shock wave theory, shockwaves propagation and speeds, shock waves at various facilities, signalized intersections, shockwaves due to special causes, shockwave modelling, case studies, and examples..

UNIT-IV:

Queuing Analysis: Queuing theory, queue discipline and patterns, deterministic analysis, stochastic analysis, single-channel, multiple channels, moving queue at bottlenecks and junctions, queuing examples for practices.

UNIT-V:

Simulation Methodologies: Fundamentals and concepts, components of traffic simulation, mathematical simulation model development, macroscopic, microscopic, and mesoscopic simulation models, software for simulation, calibration and validation simulation model, examples.

TEXT BOOKS:

1. Fundamentals of Transportation and Traffic Operations, C. S. Daganzo, Emerald, Inc., 2008
2. Introduction to Modern Traffic Flow Theory and Control, Boris S. Kerner, 1st Edition Springer, 2009
3. Traffic Flow Theory and Control, Drew D. R., McGraw Hill Book, 1976

REFERENCES:

1. Highway Capacity Manual, Transportation Research Board, Washington, DC, 2010
2. Principles of Highway Engineering and Traffic Analysis, Fred L. Mannering, and Scott S. Washburn, 5th Edition, John Wiley & Sons, 2013
3. Traffic Engineering, Roger P. Roess, Elena S. Prassas, and William R. McShane, 5th Edition, Pearson, 2019
4. Traffic Flow Fundamentals, May A. D., Prentice Hall, 1990
5. Traffic Flow Theory: A Monograph, Gerlough D. L. and Huber M. J., TRB Special Report, 1992

ONLINE RESOURCES:

1.https://www.rms.nsw.gov.au/business-industry/partners suppliers/documents/technical manuals/modellingguidelines.pdf
2.https://www.cityservices.act.gov.au/__data/assets/pdf_file/0009/1539576/ACT TrafficMicrosimulation-Modelling-Guidelines.pdf

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22PE1HW23) BIG DATA ANALYTICS IN TRANSPORTATION

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To introduce students on the concepts of data analytics
- To analyze popular algorithms and methods in data analytics
- To understand the importance of AI and ML in transportation
- To know the applications of big data in transportation

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Formulate an effective approach to capture transportation data
CO-2: Apply predictive and prescriptive analytics to transportation problems
CO-3: Examine the relevance of machine learning to transportation system operations
CO-4: Identify appropriate algorithms for data mining and machine learning

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	-	2	2	3	-	1
CO-2	3	2	3	3	-	-
CO-3	2	-	2	3	2	-
CO-4	3	2	3	3	2	-

UNIT-I:
Basics of Big Data: Introduction to Big Data, Exponential growth and the new availability of data, Structured and unstructured data, Rapid acceleration in many dimensions (volume, velocity, variety, variability, and complexity), V's of the Gartner's definition of big data, i.e., high volume, high velocity or high variety, veracity, value.

UNIT-II:
Data Exploration Visualization: Data types: Sensor data, audio, video data, combinations of data, Predicting and Forecasting methods, Sampling errors, Smart data management: Manage and understand the data. Anonymization, Aggregation, Interpretation, Processing, Modeling, Time Patterns, Spatial Signature, Flows Patterns, Open Data concepts.

UNIT-III:
Data Mining Strategies: Operations in Data Mining, Descriptive analytics, Prepares and analyze historical data, Identify patterns from samples for reporting of trends, Predictive analytics, Predicts future probabilities and trends, Relationships in data that

may not be readily apparent with descriptive analysis, Prescriptive analytics, Evolution of Computer Processors and storage methods.

UNIT-IV:

AI and Machine Learning: AI for Big data analysis, Hadoop Concepts, and application for Big Data, Scaling Out, Supported Vector Machine, Tree-based Methods, Clustering, Text Mining, Topic Modeling Sentiment Analysis, Machine learning, and TSMO, Historical performance reporting, Mechanisms related to transportation demand and supply, Future Transportation Demand and Supply, Automated transportation back office, Machine learning, and big data, Neural Network Deep Learning, Network Analysis.

UNIT-V:

Big Data Applications in Transportation: Exploring Regularity and Structure in Travel Behavior Using Smart Card Data Estimating a Rail Passenger Trip Origin-Destination Matrix Using Automatic Data Collection Systems, Automatic Data for Applied Railway Management: A Case Study on the London Overground, Trip Detection Using Sparse CDR Data based on Supervised Statistical Learning, Demand Management in Public Transit: Design and Evaluate Crowding Reduction Strategies in Hong Kong.

TEXT BOOKS:

1. Transportation Analytics in the Era of Big Data, Ukkusuri Satish V., Yang Chao, 1st Edition, Springer, 2019
2. Big Data Analytics in Traffic and Transportation Engineering: Emerging Research and Opportunities, Sara Moridpour, 1st Edition, IGI Global, 2019
3. Big Data Science and Analytics: A Hands-On Approach, Arshdeep Bahga, Vijay Madisetti, 1st Edition, VPT, 2016

REFERENCES:

1. Big Data Analytics for Connected Vehicles and Smart Cities, Bob Mcqueen, Artech House, 1st Edition, 2017
2. Data Analytics for Intelligent Transportation Systems, Mashrur Chowdhury, Amy Apon, and Kakan Dey,1st Edition, Elsevier, 2017
3. Machine Learning: A Probabilistic Perspective, Murphy K., MIT Press, 2012

ONLINE RESOURCES:

1. https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1156&context=trec_reports

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22OE1CN01) BUSINESS ANALYTICS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To understand the role of business analytics within an organization and to analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making and to become familiar with processes needed to develop, report, and analyze business data
- To use decision-making tools/Operations research techniques and to manage business process using analytical and management tools
- To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Apply knowledge of data analytics

CO-2: Think critically in making decisions based on data and deep analytics

CO-3: Use technical skills in predicative and prescriptive modeling to support business decision-making

CO-4: Translate data into clear, actionable insights

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	-	1	-	1	1
CO-2	3	-	2	-	1	2
CO-3	2	1	1	-	1	1
CO-4	1	2	1	-	1	1

UNIT-I:

Business Analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data Business Analytics Technology.

UNIT-III:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business Analytics-Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics, James Evans, Pearson Education
3. Business Analytics, Purba Halady Rao, PHI, 2013

REFERENCES:

1. Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Gert H. N. Laursen, Jesper Thorlund, 2nd Edition, Wiley Publications
2. Business Analytics: Data Analysis & Decision Making, S. Christian Albright, Wayne L. Winston, 5th Edition, 2015
3. Business Intelligence Guidebook: From Data Integration to Analytics, Rick Sherman Elsevier, 2014

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22OE1AM01) INDUSTRIAL SAFETY

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE PRE-REQUISITES: Elements of Mechanical, Civil, Electrical and Industrial Engineering

COURSE OBJECTIVES:

- To achieve an understanding of principles, various functions and activities of safety management
- To communicate effectively information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities
- To anticipate, recognize, and evaluate hazardous conditions and practices affecting people, property and the environment, develop and evaluate appropriate strategies designed to mitigate risk
- To develop professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards

CO-2: Communicate effectively on health and safety matters among the employees and with society at large

CO-3: Demonstrate the use of state of the art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations

CO-4: Interpret and apply legislative / legal requirements, industry standards, and best practices in accident prevention programmes in a variety of workplaces

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	3	2	2	3	1
CO-2	-	-	-	-	2	3
CO-3	3	1	2	1	-	-
CO-4	-	2	-	1	-	2

UNIT-I:

Safety Management: Evaluation of modern safety concepts – Safety management functions – safety organization, safety department – safety committee, safety audit -

performance measurements and motivation – employee participation in safety and productivity.

UNIT-II:

Operational Safety: Hot metal Operation – Boiler, pressure vessels – heat treatment shop - gas furnace operation-electroplating-hot bending pipes – Safety in welding and cutting. Cold-metal Operation- Safety in Machine shop- metal cutting – shot blasting, grinding, painting – power press and other machines.

Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers

UNIT-III:

Safety Measures: Layout design and material handling - Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety– Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in industrial hazards.

UNIT-IV:

Accident Prevention: Human side of safety – personal protective equipment – Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP – Training and development of employees – First Aid – Fire fighting devices – Accident reporting investigation.

UNIT-V:

Safety, Health, Welfare & Laws: Safety and health standards – Industrial hygiene – occupational diseases prevention - Welfare facilities – History of legislations related to safety–pressure vessel act- Indian boiler act- The environmental protection act – Electricity act - Explosive act.

TEXT BOOKS:

1. Safety Management, John V. Grimaldi and Rollin H. Simonds, All India Travellers Bookseller, New Delhi, 1989
2. Safety Management in Industry, Krishnan N. V., Jaico Publishing House, 1996

REFERENCES:

1. Occupational Safety Manual, BHEL
2. Industrial Safety and The Law, P. M. C. Nair Publisher's, Trivandrum
3. Managing Emergencies in Industries, Loss Prevention of India Ltd., Proceedings, 1999
4. Safety Security and Risk Management, U. K. Singh & J. M. Dewan, A. P. H. Publishing Company, New Delhi, 1996
5. Industrial Safety Management: Hazard Identification and Risk Control, L. M. Deshmukh, McGraw-Hill, 2005

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22OE1AM02) OPERATIONS RESEARCH

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To analyze linear programming models in practical and their practical use
- To apply the transportation, assignment and sequencing models and their solution methodology for solving problems
- To apply inventory and queuing, inventory models and their solution methodology for solving problems
- To evaluate the simulation models

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Evaluate the problems using linear programming
CO-2: Analyze assignment, transportation problems
CO-3: Apply inventory and queuing problems for real time problems
CO-4: Model the real-world problem and simulate it

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	3	3	2	-	-
CO-2	1	3	3	3	-	-
CO-3	1	3	3	3	-	-
CO-4	1	3	3	3	-	-

UNIT-I:

Introduction to Operations Research: Definitions of OR, Characteristics of OR, Scope of OR, Classification of Optimization Techniques, models in OR, General L.P Formulation, Graphical solution, Simplex Techniques.

Allocation: Linear Programming Problem Formulation- Graphical solution-Simplex method-Artificial variables technique-Two phase method, Big-M Method-Duality Principle.

UNIT-II:

Transportation Problem: Formulation-Optimal solution-unbalanced transportation problem-Degeneracy. Assignment problem-Formulation-Optimal solution-Variations of Assignment Problem-Travelling Salesman Problem.

Sequencing: Introduction-Flow Shop sequencing-n jobs through two machines-n jobs through three machines-Job shop sequencing-two jobs through m machines.

UNIT-III:

Waiting Lines: Introduction-Single channel-Poisson arrivals-exponential service times-with infinite population and finite population models-Multichannel-Poisson arrivals-exponential service times with infinite population single channel Poisson arrivals.

UNIT-IV:

Inventory Models: Deterministic inventory, models - Probabilistic inventory control models

UNIT-V:

Simulation: Definition-Types of simulation models-phases of simulation-applications of simulation Inventory and Queuing problems-Advantages and Disadvantages-Brief Introduction of Simulation Languages.

TEXT BOOKS:

1. Operations Research, S. D. Sharma, Kedarnath Ramnath, Meerut, New Delhi
2. Engineering Optimization, S. S. Rao, New Age International Publications, 2014
3. Introduction to Genetic Algorithms, S. N. Sivanandam, Springer

REFERENCES:

1. Operations Research-An Introduction, H. A. Taha, PHI, 2008
2. Principles of Operations Research, H. M. Wagner, PHI, Delhi, 1982
3. Introduction to Optimization: Operations Research, J. C. Pant, Jain Brothers, Delhi, 2008

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22OE1AM03) ENTREPRENEURSHIP AND START-UPS

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:

- To motivate the engineers to inculcate the skills thereof in any professional role and to consider intrapreneurship or entrepreneurship as career choices for personal and societal growth
- To understand different Theories of Entrepreneurship and their Classification
- To create Feasibility Reports, Business, Project Plans and resolve Operational problems
- To understand the roles of Family, non-family entrepreneurs and learning about Startups' Opportunities, Corporate Legal and Intellectual Property related issues

COURSE OUTCOMES: After completion of the course, the student should be able to

CO-1: Understand the role of an entrepreneur in the economic development and discover societal problems as entrepreneurial opportunities and ideate to develop solutions through systematic and creative approaches to innovation and business strategy

CO-2: Learn different Theories of entrepreneurship, the role of Family and Non-Family entrepreneurs and problem-solving skills

CO-3: Create Marketing, Financial Plans and evaluate Structural, Financial and Managerial Problems

CO-4: Apply lean methodology to startup ideas using Business Model Canvas and be able to create Business Plans through establishing business incubators. Understand Corporate Legal and Intellectual Property related matters

COURSE ARTICULATION MATRIX:

*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	-	3
CO-2	1	-	-	-	-	2
CO-3	1	-	-	-	-	2
CO-4	-	-	-	1	-	-

UNIT-I:

Entrepreneurship: Definition of Entrepreneur, Entrepreneurial motivation and barriers; Internal and external factors; Types of entrepreneurs, Personality and Skill Set of an Entrepreneur, Entrepreneurship as a career for engineers, scientists, and technologists.

UNIT-II:

Theories of Entrepreneurship: Classification of entrepreneurship. Creativity and Innovation: Creative Problems Solving, Creative Thinking, Lateral Thinking, Views of De Bono, Khandwala and others, Creative Performance in terms of motivation and skills.

Family and Non-Family Entrepreneurs: Role of Professionals, Professionalism vs. family entrepreneurs, Role of Woman entrepreneur, Sick industries, Reasons for Sickness, Remedies for Sickness, Role of BIFR in revival, Bank Syndications.

UNIT-III:

Creativity and Entrepreneurial Plan: Idea Generation, Screening and Project Identification, Creative Performance, Feasibility Analysis: Economic, Marketing, Financial and Technical; Project Planning, Evaluation, Monitoring and Control, segmentation, Targeting and positioning of Product, Role of SIDBI in Project Management.

UNIT-IV:

Operation Problems: Incubation and Take-off, Problems encountered Structural, Financial and Managerial Problems, Types of Uncertainty. Institutional support for new ventures: Supporting organizations; Incentives and facilities; Financial Institutions and Small-scale Industries, Govt. Policies for SSIs.

UNIT-V:

Startups' Opportunity Assessment, Business Models, Entrepreneur talk, Clinical/ Regulatory, Sector Specific Group Briefing by Advisory Committee, Corporate Legal and Intellectual Property, Pitching, Payers and Reimbursement, Pitch practice, Investors, Mistakes I Won't Repeat, Business Development and Exits, Finance, Budgeting, Team Building, Opportunities in Telangana State and India – incubators, schemes, accelerators.

TEXT BOOKS:

1. Understanding Enterprise: Entrepreneurship and Small Business, Bridge S. et al., Palgrave, 2003
2. Holt- Entrepreneurship: New Venture Creation, Prentice-Hall, 1998
3. Entrepreneurship Development, Robert D. Hisrich, Michael P. Peters, Tata McGraw Hill Edition

REFERENCES:

1. New Venture Creation: An Innovator's Guide to Entrepreneurship, Marc H. Meyer and Frederick G. Crane, 2nd Edition, Sage Publications
2. Technology Ventures: From Idea to Enterprise, Byers, Dorf, Nelson
3. Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist - Feld, Mendelson, Costolo
4. Breakthrough Entrepreneurship, Burgstone and Murphy
5. Business Model Generation, Alexander Osterwalder

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester

(22OE1PL01) WASTE TO ENERGY

TEACHING SCHEME		
L	T/P	C
3	0	3

EVALUATION SCHEME				
SE	CA	ELA	SEE	TOTAL
30	5	5	60	100

COURSE OBJECTIVES:
- To create awareness in students of energy conservation
- To identify the use of different types of Bio waste energy resources
- To understand different types of bio waste energy conservations
- To detect different waste conversion into different forms of energy

COURSE OUTCOMES: After completion of the course, the student should be able to
CO-1: Find different types of energy from waste to produce electrical power
CO-2: Estimate the use of bio waste to produce electrical energy
CO-3: Understanding different types of bio waste and its energy conversions
CO-4: Analyze the bio waste utilization and to avoid the environmental pollution

COURSE ARTICULATION MATRIX:
*(Define Correlation of Course Outcomes with Program Outcomes and Program Specific Outcomes using **mapping levels 1 = Slight, 2 = Moderate and 3 = Substantial**)*

CO	PROGRAM OUTCOMES (PO)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	2	3	1	2	1
CO-2	3	3	3	3	2	3
CO-3	3	2	3	2	2	3
CO-4	3	3	3	3	2	3

UNIT-I:
Introduction to Energy From Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW (Municipal solid waste) – Conversion devices – Incinerators, Gasifiers, Digestors. Urban waste to energy conversion, Biomass energy Programme in India.

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III:
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power.

UNIT-IV:

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion.

Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:

1. Biogas Technology-Transfer and Diffusion, M. M. EL-Halwagi, Elsevier Applied Science Publisher, 1984
2. Introduction to Biomass Energy Conversions, Sergio Capareda

REFERENCES:

1. Non-Conventional Energy, Desai Ashok V., Wiley Eastern Ltd., 1990
2. Biogas Technology - A Practical Hand Book, Khandelwal K. C. and Mahdi S. S., Vol. I & II, Tata McGraw Hill, 1983
3. Food, Feed and Fuel from Biomass, Challal D. S., IBH Publishing Co. Pvt. Ltd., 1991
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996