JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D93101	Highway Infrastructure Design	PC	3	0	0	3
2.	21D93102	Urban Transportation Planning	PC	3	0	0	3
3.	21D93103a 21D93103b 21D93103c	**Program Elective Course - I** Traffic Engineering Project Management Bridge Engineering	PE	3	0	0	3
4.	21D93104a 21D93104b 21D21103a	**Program Elective Course - II** Pavement Materials and Properties Ground Improvement Methods Advanced Concrete Technology	PE	3	0	0	3
5.	21D93105	Pavement Material Testing Lab	PC	0	0	4	2
6.	21D93106	Traffic Studies Lab	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
		Total					**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D93201	Highway Project Formulation and Economics	PC	3	0	0	3
2.	21D93202	Pavement Construction, Maintenance &Management	PC	3	0	0	3
3.	21D93203a 21D93203b 21D93203c	**Program Elective Course – III** Pavement Analysis and Design Road Safety Engineering Land Use and Transportation Modelling	PE	3	0	0	3
4.	21D93204a 21DBS201 21D93204b	**Program Elective Course – IV** Traffic Analysis Applied Statistics GIs Applications in Transportation Engineering	PE	3	0	0	3
5.	21D93205	Advanced Pavement Engineering Lab	PC	0	0	4	2
6.	21D93206	Traffic Analysis and Software Lab	PC	0	0	4	2
7.	21D93207	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
Total							**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.		**Program Elective Course – V**	PE	3	0	0	3
	21D93301a	Environmental Impact Assessment for Transportation Projects					
	21D93301b	Transportation system management					
	21D93301c	Intelligent Transportation Systems					
2.		**Open Elective**	OE	3	0	0	3
	21DOE301a	Cost Management of Engineering Projects					
	21DOE301b	Industrial safety					
	21DOE301d	Operations Research					
3.	21D93302	Dissertation Phase – I	PR	0	0	20	10
4.	21D93303	Co-curricular Activities					2
Total							**18**

SEMESTER - IV

S.No.		Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D93401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	HIGHWAY INFRASTRUCTURE DESIGN	L	T	P	C
21D93101		3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- Students will develop a good command of the concepts involved in `geometric design of intersections, horizontal & vertical alignment of roads & pedestrian facilities.
- Students can describe the urban street hierarchy and functional classification system.
- Identify and define the elements of a roadway cross-section. Discuss concepts related to the roadway design speed.
- They can discuss alignment and grade elements including sight distance; horizontal and vertical curves; terrain and acceptance grades for urban local and collector streets.
- They can define the functional area of an intersection. Identify key design elements for intersections.
- They can identify pedestrian street crossing issues.

Course Outcomes (CO): After completion of the course the student will be able to

- Design the longitudinal and cross-sectional elements of a highway.
- Design the horizontal and vertical alignment of roads.
- Design the intersections, interchanges, and parking facilities.
- Design the facilities for bicyclists and pedestrians.

UNIT - I	Lecture Hrs:10

Highway Classification and Cross Section Elements : Functional Classification of Highway System; Carriageway, Shoulders, Formation, Right of Way; Kerbs, Foot Paths, Medians-Design Specifications.
Pavement Surface Characteristics – Skid Resistance, Factors Affecting Skid Resistance, Measurement of Skid Resistance; Road Roughness, Measurement of Road Roughness; Camber, Objectives of Camber, Design Standards.

UNIT - II	Lecture Hrs:10

Sight Distances and Geometric Design:
Sight Distances: Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance. Importance of Sight Distances in `Horizontal and Vertical Curves.
Horizontal and Vertical Alignment: Objectives of Horizontal Curves; Super Elevation – Need for Super Elevation; Method of Computing Super Elevation; Minimum Radius of Curve; Methods of Attainment of Super Elevation; Extra Widening On Curves; Transition Curves – Objectives and Design. Gradients – Types of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves and Design Criteria for Vertical Curves; Combination of Vertical and Horizontal Curves – Grade Compensation.

UNIT - III	Lecture Hrs:10

Intersection Design: Types of Intersections; Design Principles for Intersections; Design of At-Grade Intersections – Channelization, Objectives; Traffic Islands and Design Standards; Rotary Intersection – Concept and Design, Advantages and Disadvantages; Grade Separated Interchanges – Types, Warrants and Design Standards.

UNIT - IV	Lecture Hrs:9

Traffic Signs and Road Markings : Types of Road Signs; Guidelines for The Provision of Road Signs; Cautionary Signs, Regulatory Signs, Information Signs – Design Standards; **Road Markings**: Objectives of Road Markings; Types of Road Markings; Role of Road Markings in `Road Safety and Traffic Regulation; Specification for Road Markings. Highway Appurtenances – Delineators, Traffic Impact Attenuators, Safety Barriers.

UNIT - V	Lecture Hrs:9

Miscellaneous Elements: Requirements of Pedestrians; Pedestrian Facilities On Urban Roads; Cycle Tracks – Guidelines and Design Standards; Bus Bays – Types and Guide Lines; Design of On-

Street and Off Street Parking Facilities – Guidelines for Lay Out of On-Street and Off Street Parking
Textbooks:
1. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal, Khanna Publications 2. Traffic Engineering and Transportation Planning, L.R.Kadiyali, Khanna Publications
Reference Books:
1. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers. 2. IRC Codes for Signs, Markings and Mixed Traffic Control in `Urban Areas.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	URBAN TRANSPORTATION PLANNING	L	T	P	C
21D93102		3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- The course introduces students tothe fundamentals of Urban transportation planning.
- It familiarizes students with contemporary transportation planning issues and methods of analysis.
- The course presents relationships between transportation and urban land use systems and new tools toaddress environmental and quality of life impacts of transportation are presented.

Course Outcomes (CO): After completion of the course the student will be able to

- Identify Urban transportation problems and understand the principles of planning.
- Organize and conduct various types of surveys
- Apply travel demand estimation techniques
- Plan sustainable urban mobility and evaluate alternate improvements.
- Identify design issues in `metropolitan cities.

UNIT - I — Lecture Hrs:10

Urban Transportation Planning and Travel Demand: Urban Issues, Travel Characteristics, Evolution of Planning Process, Supply and Demand – Systems Approach. Overall Planning Process, Long Term Vs Short Term Planning.
Travel Demand Function, Independent Variables, Travel Attributes, Assumptions in ` Travel Demand Estimation, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques.

UNIT - II — Lecture Hrs:10

Data Collection and Inventories: Collection of Data – Organisation of Surveys and Analysis, Study Area-_Definition and Guidelines, Zoning Principles, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources.

UNIT - III — Lecture Hrs:10

Trip Generation and Distribution : Definition of Trip –Trip Characteristics- Types of Trips – Home Based and Non-Home Based Trips – Factors Affecting Trip Making Behaviour -Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction Models.
Trip Distribution: Growth Factor Methods- Uniform Growth Factor – Average Growth Factor – Fratar Method– Advantages and Disadvantages of Growth Factors. Gravity Model – Formulation and Calibration.

UNIT - IV — Lecture Hrs:9

Mode Choice and Traffic Assignment: Factors Affecting Mode Choice-Mode Choice Behaviour - Competing Modes, Mode Split Curves, Models and Probabilistic Approaches-Use of Diversion Curves.

UNIT - V — Lecture Hrs:9

Traffic Assignment: Basic Elements of Transport Networks, Coding, Route Properties, Minimum Path, **Assignment Techniques:**All-Or-Nothing Assignment, Capacity Restraint Technique, Multiple Route Assignment. Basic Numerical Examples.

Textbooks:

1. Introduction toTransportation Planning by C.J. Chisty.
2. Transportation Engineering & Planning by C.S. Papacostas.
3. Introduction toTransportation Planning – M.J.Bruton; Hutchinson of London Ltd.

Reference Books:

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1. Traffic Engineering and Transport Planning - Kadiyali L.R., Khanna Publishers
2. Lecture Notes On UTP - Prof. S. Raghavachari , R.E.C.Warangal.
3. Metropolitan transportation planning – John W. Dickey, Tata Mc Graw Hill, New Delhi,1975.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	TRAFFIC ENGINEERING	L	T	P	C
21D93103a	(PE-I)	3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- To understand traffic, its properties, measurement, simulation and control.
- To understand traffic flow variables and their measurement. Survey methods and data analysis techniques required by traffic engineers are presented.
- To compute highway capacity & level of service
- To understand Parking analysis, traffic safety, traffic signal control, regulation and signal design
- To Detrimental effects of traffic on environment, Air and Noise pollution are discussed.

Course Outcomes (CO): After completion of the course the student will be able to

- To Understand Basic traffic Characteristics
- To Understand the importance of capacity and LOS
- To Analyze design issues related toparking & traffic signal
- To know concepts of Traffic Control, Regulation Signal Coordination:
- To Understand the detrimental effect of traffic on environment.

UNIT - I — Lecture Hrs:10

Traffic Characteristics Measurement and Analysis:
Basic Traffic Characteristics - Speed, Volume and Concentration. Relationship Between Flow, Speed and Concentration. Traffic Measurement and Analysis - Volume Studies - Objectives, Methods.
Speed Studies – Objectives, Definition of Spot Speed, Time Mean Speed and Space Mean Speed; Methods of Conducting Speed Studies; Presentation of Speed Study Data; Head Ways and Gaps; Critical Gap; Gap Acceptance Studies.

UNIT - II — Lecture Hrs:10

Highway Capacity and Level of Service: Basic Definitions Related toCapacity; 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. Numerical Exercises.

UNIT - III — Lecture Hrs:10

Parking Analysis: Types of Parking Facilities – On-Street Parking and Off-Street Parking Facilities; Parking Studies and Analysis- Parking Inventory Study, Parking Usage Study by Patrolling, Questionnaire Survey, Cordon Surveys; Evaluation of Parking Parameters; Parking Accumulation, Parking Load, Parking Turnover, Parking Index, Parking Volume. Numerical Exercises.

UNIT - IV — Lecture Hrs:9

Traffic Safety :Accident Studies and Analysis; Causes of Accidents - The Road, The Vehicle, The Road User and The Environment; Engineering, Enforcement and Education Measures for The Prevention of Accidents. Accident Data Recording – Condition Diagram, Collision Diagram.

UNIT - V — Lecture Hrs:9

Traffic Control, Regulation Signal Coordination: Traffic Signals –Types of Signals; Principles of Phasing; Timing Diagram; Design of Isolated Traffic Signal by Webster Method, Warrants for Signalization. Optimum Cycle Time- Saturation Flow Rate – Corrections for Left and Right Turns – Numerical Exercises.
Signal Coordination: Signal Co-Ordination Methods, Simultaneous, Alternate, Simple Progression and Flexible Progression Systems.

Textbooks:

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1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers.
2. Principles of Highways Engineering and Traffic Analysis – Fred Mannering & Walter Kilareski, John Wiley & Sons Publication
3. Traffic Engineering - Theory & Practice - Louis J.Pignataro, Prentice Hall Publication.

Reference Books:

1. Transportation Engineering - An Introduction - C.Jotin Khisty, Prentice Hall Publication.
2. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
3. I.T.E. Traffic Engineering Hand Book.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PROJECT MANAGEMENT	L	T	P	C
21D93103b	(PE – I)	3	0	0	3
	Semester	**I**			

Course Objectives: This Course will fulfil the following Objectives:

- Introduce tothe students the concepts of Organization, Management , Leadership and Team work and Project Management Information System
- Make the students familiarize with concepts of Cost estimation, Resource Planning, Break-even Analysis and Life Cycle Analysis
- Make the students tounderstand Laws of Contracts, Documentation, Arbitration and Quality Management related Issues
- Make students tograsp the Tools for Project Scheduling, Human Resources management and Inventory management

Course Outcomes (CO): After completion of the course the student will be able to:

- Understand the concepts of Organization, Management , Leadership and Team work and Project Management Information System
- Apply the concepts of Cost estimation, Resource Planning, Break-even Analysis and Life Cycle Analysis toreal life projects
- Understand Laws of Contracts, Documentation, Arbitration and Quality Management related Issues
- Grasp the use of Tools for Project Scheduling and Monitoring
- To understand the practices of Human Resources management and Inventory management

UNIT - I Lecture Hrs:10

Concepts, Organisation, Management Functions, Overview of Management Objectives, Tools and Techniques.
Project Management – Processes and Organisational Structures – Team Management – Project Manager as a Team Leader – Leadership Qualities, PMIS

UNIT - II Lecture Hrs:10

Construction Cost and Value Engineering: Types of Estimates, Implementation of Cost Controls, Project Cost Forecasting, Cost Optimisation and Resources Planning -Value Engineering. Techniques for Project Selection, Break-Even Analysis, Cost Modelling, Energy Modelling, Life Cycle Cost Approach.

UNIT - III Lecture Hrs:10

Contract Management in `Construction Industry, Quality Control and Safety: Tendering and Contracting, Laws of Contracts, subcontracts, Potential Problems, Post Contract Problems, Documents, Conditions, Arbitration, Special Features of International Contracts.
Quality Management and Safety in `Construction Industry. Quality control by statistical methods, sampling plan, control charts, ISO 14000, Safety Measures, Safety Programmes, Safety Awareness and Implementation of Safety Plan – Compensation.

UNIT - IV Lecture Hrs:9

Project Scheduling and Analysis Methods:CPM, PERT, Linear programming, queuing concept, simulation, bidding models, game theory; Numerical Examples.

UNIT - V Lecture Hrs:9

Human Resource Management and Construction Management Practices : Man Power Planning – Training – Motivation – Industrial Relations – Welfare Measures – MIS – Components and Structure – Personal Management. Resource Management and Inventory -Basic concepts, labour requirements & productivity, non-productive activities, site productivity, equipment and material management, inventory control. Construction Management Practices - Implementation of Procedures and Practices – International Experiences – Case Studies – Examples.

Textbooks:

1. Project Management - A systems approach to Planning, Scheduling and Controlling- Herold Kerzner - CBS Publishers and Distributors.
2. Fundamentals of Construction Management and Organisations - K.Waker A Teraih and Jose M.Grevarn.

Reference Books:

1. Indian highways – a framework for commercialization by Gajendra Haldia
2. Risk management in construction projects NCP-centre of distance education for construction industry manager

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	BRIDGE ENGINEERING	L	T	P	C
21D93103c	(PE - I)	3	0	0	3
	Semester	I			

Course Objectives: This Course will fulfil the following Objectives:

- Introducing the students todifferent types of Bridges and Loads acting on them
- Familiarize the students with the Design and Analysis of Girder Bridges and Continuous Bridges
- Familiarize the students with the Design and Analysis of Prestressed Concrete Bridges
- Providing knowledge on various components of Bridges and the design standards associated with them
- Provide insight into the analysis of Deck Slabs and Substructure of Bridges

Course Outcomes (CO): After completion of the course the student will be able to

- Understands the types of Bridges, the components of Bridges and the loads acting on them
- Grasp the concepts of the Design and Analysis of Girder Bridges and Continuous Bridges
- Understand the Design and Analysis of Prestressed Concrete Bridges
- Comprehend the General design Concepts related toPrestressing and Composite sections
- Get an insight into the analysis of Deck Slabs and Substructure of Bridges

UNIT - I Lecture Hrs:10

Concrete Bridges: Introduction-Types of Bridges-Economic span length-Types of loading-Dead load-live load-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces-Seismic loads.
Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of roadway and footway-General Design Requirements.

UNIT - II Lecture Hrs:10

UNIT-II:
Solid slab, Girder Bridges & Continuous Bridges: Introduction-Method of Design. Girder Bridges - Introduction-Method of Design-Courbon's Theory. Continuous Bridges - Introduction-Span lengths- Analysis of Continuous bridges-Decking of Girders with constant Moment of Inertia.
Continuous bridges with variable Moment of Inertia-Method of Analysis -Girders with Parabolic Soffit-Method of plotting Influence lines-Girders with Straight Haunches-Design steps for Continuous Bridges.

UNIT - III Lecture Hrs:10

Pre-Stressed Concrete Bridges: Basic principals- Method of Pre-srtessing- Pretensioning and Post-tensioning – Comparision-Freyssinet Method-Magnel-Blanet System-Lee-Mc call system-Basic Assumptions-Losses in ` Prestress-Equation based on Initial and final stress conditions-Cable Zone- Design of selections-Condition of first crack- Ultimate load design-Shear-Vertical Prestressing-Diagonal Tension in ` I-section-End Block-Magnel's method-Emperical Method.

UNIT - IV Lecture Hrs:9

General Design requirements-Mild steel reinforcement in `prestessed concrete member-Concrete cover and spacing of pre-stressing steel-Slender beams-Composite Section-Propped-Design of Propped Composite Section- Unpropped composite section-Two-stage Prestressing-Shrinking stresses-General Design requirements for Road Bridges.

UNIT - V Lecture Hrs:9

Analysis of Bridge Decks and Substructure: Harmonic analysis and folded plate theory-Grillage analogy- Finite strip method and FEM.
Sub-structure of bridges: Substructure-Beds block-Piers- Pier Dimensions- Design loads for piers- Abutments- Design loads for Abutments.

Textbooks:

1. Design of Concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani. 2. Bridge Deck Behaviour by E.C.Hambly. 3. Prestressed Concrete bridges by N. Krihnam Raju
Reference Books:
1. Concrete Bridge Design and Practice by V.K.Raina. 2. Prestress Concrete – A fundamental Approach. Edward Navy 3.Relevant IRC and IS Code Books **Note: This subject must be taught by M-Tech. Structural Engineering, faculty only**

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M.TECH. IN HIGH WAY ENGINEERING
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Course Code	PAVEMENT MATERIALS and PROPERTIES	L	T	P	C
21D93104a	(PE-II)	3	0	0	3
	Semester	I			

Course Objectives: This Course Objectives are listed below:

- The main objective of this course is toprovide students with a thorough understanding of the basic Pavement materials and their desired Properties
- To familiarize the students with Bituminous Concrete Mixes
- To make student tounderstand Bitmen Modification and use of Cement Concrete Mixes in `Pavements
- Introduce the students tovarious Advanced Concrete Types

Course Outcomes (CO): After completion of the course the student will be able to

- Understand the materials required for Pavement Construction and their properties
- Characterize the pavement materials including soil, aggregate, cement, asphalt mixtures, cement concrete.
- Understand the concepts of Soil stabilization and Bitumen Modification
- Familiarize with the different types of Concretes
- Understand the basic of cement & cement concrete mix characterization.

UNIT - I — Lecture Hrs:10

Subgrade Soil: Requirements of Subgrade Soil; Different Types of Soils, Mechanical Properties of Soil; Soil Classification; Index Properties of Soil; Different Laboratory and In-Situ Procedures for Evaluating The Mechanical Properties of Soils Viz. SPT, DCPT, CPT, CBR, Plate Load Test & Resilient Modulus; Suitability of Different Types of Soil for The Construction of Highway Embankments and Pavement Layers; Field Compaction and Control. Dynamic Properties of Soil;FWD Test.

UNIT - II — Lecture Hrs:10

Aggregates: Origin, Classification, Types of Aggregates; Sampling of Aggregates; Mechanical and Shape Properties of Aggregates, Tests on Aggregate, Aggregate Texture and Skid Resistance, Polishing of Aggregates; Proportioning and Blending of Aggregates: Super Pave Gradation, Fuller and Thompson's Equation ; Use of Locally Available Materials in `Lieu of Aggregates.

UNIT - III — Lecture Hrs:10

Bitumen and Bituminous Concrete Mixes : Bitumen Sources and Manufacturing, Chemistry of Bitumen, Bitumen Structure, Rheology of Bitumen, Elastic Modulus, Dynamic Modulus, Visco-Elastic and Fatigue Properties, Creep Test, Stiffness Modulus of Bitumen Mixes Using Shell Nomographs; Resilient, Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent Deformation , Parameters and Other Properties.
Modified Bitumen: Crumb Rubber Modified Bitumen, Natural Rubber Modified Bitumen, Polymer Modified Bitumen; Introduction toEmulsified Bitumen and Its Characterization; Desirable Properties of Bituminous Mixes, Design of Bituminous Mixes: Modified Marshall's Specifications, Introduction toSuper Pave Mix Design Procedure.

UNIT - IV — Lecture Hrs:9

Cement and Cement Concrete Mixes : Types of Cements and Basic Cement Properties, Special Cements; Quality Tests on Cement; Tests on Cement Concrete Including Compressive Strength, Flexural Strength, Modulus of Elasticity and Fatigue Properties.

UNIT - V — Lecture Hrs:9

Introduction to Advanced Concretes:Self Compacted Concrete, Light Weight Concrete, Roller Compacted Concrete for Pavement Application; IS Method of Cement Concrete Mix Design With Case Studies; Role of Different Admixtures in ` Cement Concrete Performance; Joint Fillers for Jointed Plain Cement Concrete Pavements .

Textbooks:
1. Highway Materials, Soils and Concretes- Atkins, N. Harold, Fourth Edition, 2002, Prentice-Hall. 2. Highway Materials- Kerbs Robert D. and Richard D. Walker, McGraw-Hill, 1971. 3. Das, A. and Chakroborty, P. Principles of Transportation Engineering, 1st Edition, PHI Publication
Reference Books:
1. Relevant IRC and IS Codes of Practices. 2. Pavement design and materials. Papagiannakis by A. Thomas, and Eyad A. Masad, John Wiley & Sons. 3. "*The Shell Bitumen Handbook*", Fifth edition, Read, J. and Whiteoak, D., Thomas Telford Publishing, London 2003.

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Course Code	GROUND IMPROVEMENT METHODS	L	T	P	C
21D93104b	(PE– II)	3	0	0	3
	Semester	I			

Course Objectives: This Course Will fulfil the following OBJECTIVES:

- Provide a introduction to the design and philosophy of geotechnical site investigations and a legislation element incorporating contaminated land.
- Students will learn about the range of exploration and testing techniques available to geotechnical engineers.
- Students will also learn how investigations are planned and how the results of investigations relate to the design process.

Course Outcomes (CO): After completion of the course the student will be able to

- Identify ground conditions and suggest method of improvement
- Understand the principles of Mechanical Modification
- Understand the principles of Hydraulic Modification
- Understand the principles of Physical and Chemical Modification
- Understand the concepts of Modification by Inclusions and Confinement

UNIT - I		Lecture Hrs:10

Introduction to Engineering Ground Modification: Need and Objectives, Identification of Soil Types, in ` Situ and Laboratory Tests to Characterise Problematic Soils; Mechanical, Hydraulic, Physico-Chemical, Electrical, Thermal Methods, and Their Applications.

UNIT - II		Lecture Hrs:10

Mechanical Modification – Deep Compaction Techniques- Blasting Vibrocompaction, Dynamic Tamping and Compaction Piles.

UNIT - III		Lecture Hrs:10

Hydraulic Modification – Objectives and Techniques, Traditional Dewatering Methods and Theirchoice, Design of Dewatering System, Electro-Osmosis, Electro-Kinetic Dewatering. Filtration, Drainage and Seepage Control With Geosynthetics, Preloading and Vertical Drains,

UNIT - IV		Lecture Hrs:9

Physical and Chemical Modification – Modification by Admixtures, Shotcreting and Guniting Technology, Modification At Depth by Grouting, Crack Grouting and Compaction Grouting, Jet Grouting, Thermal Modification, Ground Freezing.

UNIT - V		Lecture Hrs:9

Modification by Inclusions and Confinement - Soil Reinforcement, Reinforcement With Strip, and Grid Reinforced Soil. In-Situ Ground Reinforcement, Ground Anchors, Rock Bolting and Soil Nailing.

Textbooks:

1. Engineering Principles of Ground Modifications - Hausmann, M. R. (1990) –,Mcgraw Hill Publications
2. Ground Improvement, M. P. Moseley and K. Krisch (2006) , II Edition –, Taylor and Francis
3. Ground Control and Improvement- Xianthakos, Abreimson and Bruce

Reference Books:

1. Designing With Geosynthetics- Koerner, R. M (1994) – Prentice Hall, New Jersey
2. Earth Reinforcement and Soil Structures- Jones C. J.F.P. (1985) – Butterworths,London.
3. Ground Improvement by Deep Vibratory Methods- K. Krisch & F. Krisch (2010) - Spon Press.
4. Foundation Design Principles and Practices- Donald P Coduto – 2nd edition, Pearson, Indian edition, 2012.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
21D21103a	(PE-II)	3	0	0	3
	Semester	I			

Course Objectives: This Course will fulfil the following objectives: :

- To study the properties of concrete making materials
- To do mix design
- Famiiar with the methods of concrete
- Knowledge about advance tests on concrete

Course Outcomes (CO): After completion of the course the student will be able to

- To be familiar with the properties of concrete making materials
- Identify the influence and compatibility of chemical, mineral admixtures in concrete
- Update the knowledge on recent advances in special concretes.
- Know about various methods of concrete
- Analyse the performance of concrete structure through microstructure analysis

UNIT - I Lecture Hrs:10

Cements and Admixtures: Portland Cement – Chemical Composition - Hydration, Setting and Finenesses of Cement – Structures of Hydrated Cement – Mechanical Strength of Cement Gel - Water Held in `Hydrate Cement Paste – Heat of Hydration of Cement – Influence of Compound Composition on Properties of Cement – Tests on Physical Properties of Cement – I.S. Specifications – Different Types of Cements – Admixtures.

UNIT - II Lecture Hrs:10

Aggregates: Classification of Aggregate – Particle Shape and Texture – Bond Strength and Other Mechanical Properties of Aggregate Specific Gravity, Bulk Density, Porosity, Absorption and Moisture in `Aggregate – Soundness of Aggregate – Alkali – Aggregate Reaction, Thermal Properties – Sieve Analysis – Fineness Modulus – Grading Curves – Grading Requirements – Practical Grading – Road Note No.4 Grading of Fine and Coarse Aggregates Gap Graded Aggregate – Maximum Aggregate Size.

UNIT - III Lecture Hrs:10

Fresh Concrete: Workability – Factors Affecting Workability – Measurement of Workability by Different Tests – Effect of Time and Temperature on Workability – Segregation and Bleeding – Mixing and Vibration of Concrete – Quality of Mixing Water.

Hardened Concrete: Water/Cement Ratio-Abram's Law – Gel Space Ratio – Effective Water in `Mix – Nature of Strength of Concrete – Strength in `Tension and Compression- Griffith's Hypothesis – Factors Affecting Strength – Autogeneous Healing –Relation Between Compression and Tensile Strength – Curing and Maturity of Concrete Influence of Temperature on Strength – Steam Curing – Testing of Hardened Concrete – Compression Tests – Tension Tests – Factors Affecting Strength – Flexure Tests – Splitting Tests – Non Destructive Testing Methods.

UNIT - IV Lecture Hrs:9

Elasticity, Shrinkage and Creep: Modulus of Elasticity – Dynamic Modulus of Elasticity – Poisson's Ratio – Early Volume Changes – Swelling – Draying Shrinkage - Mechanism of Shrinkage – Factors Affecting Shrinkage – Differential Shrinkage – Moisture Movement Carbonation Shrinkage-Creep of Concrete – Factors Influencing Creep – Relation Between Creep and Time – Nature of Creep – Effect of Creep.

UNIT - V Lecture Hrs:9

Mix Design: Proportioning of Concrete Mixes by Various Methods – Fineness Modulus, Trial and Error, Mix Density, Road Note. No. 4, ACI and ISI Code Methods – Factors in `The Choice of Mix Proportions – Durability of Concrete – Quality Control of Concrete – Statistical Methods – High Strength Concrete Mix Design. **Special Concrete's**: Light Weight Concretes –

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Light Weight Aggregate Concrete- Cellular Concrete - No Fines Concrete – High Density Concrete – Fiber Reinforced Concrete – Different Types of Fibers - Factories Affecting Properties of FRC – Applications Polymer Concrete – Types of Polymer Concrete Properties of Polymer Concrete and Applications
Textbooks:
1. Properties of Concrete by A.M.Neville – Pearson Publication – 4th Edition 2. Concrete Technology by M.S.Shetty. – S.Chand & Co. ; 2004 3. Concrete Technology by A.M.Neville – Pearson Publication
Reference Books:
1. Design of Concrete Mix by Krishna Raju, CBS Pubilishers. 2. Concrete: Micro Structure, Properties and Materials – P.K.Mehta and J.M.Monteiro, Mc-Graw Hill Publishers 3. Concrete Technology by A.R. Santha Kumar, Oxford University Press, New Delhi 4. Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi 5. Non-Destructive Test and Evaluation of Materials by J.Prasad & C.G.K. Nair , Tata Mcgraw Hill Publishers, New Delhi

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PAVEMENT MATERIALS TESTING LAB	L	T	P	C
21D93105		0	0	4	2
	Semester	I			

Course Objectives: The students will acquire knowledge about

- Objective material characterization of aggregates.
- Fundamental tests on Bitumen

Course Outcomes (CO): : At the end of the course, students will be able to:

- Characterize the pavement materials.
- Perform quality control tests on pavements and pavement materials.
- Conduct test on Aggregate & bitumen.

List of Experiments:

1. Test on Soil – i) Soil Consistency Tests, Sieve Analysis
ii) Compaction of Soil
iii) CBR Test

2. Test on Aggregate – i) Shape Test
ii) Impact and Crushing Tests on Aggregate
iii) Abrasion and Attrition Test
iv) Soundness Test

3. Tests on Bitumens – i) Viscosity, Penetration, Ductility Tests
ii) Flash and Fire Point Tests
iii) Bitumen Extraction Tests

4. Test on Bitumen & Concrete Mix:
i) Design of Cement Concrete Mix for Highway
ii) Marshal Stability Mix Design

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	TRAFFIC STUDIES LAB	L	T	P	C
21D93106		0	0	4	2
	Semester	I			

Course Objectives: : The students will acquire knowledge about

- Analyzing characteristics of traffic
- Various parameter related todelay, speeds and headways

Course Outcomes (CO): At the end of the course, students will be able to:

- Gain Knowledge about various traffic surveys
- Analyze traffic parameters from various studies.

List of Experiments:

1. **Traffic Surveys:**

   i. Traffic Volume Studies
   ii. Spot Speed Studies
   iii. Floating Car Technique
   iv. Headway and Gap-Acceptance Studies
   v. Delay Studies
   vi. Pedestrian Survey

2. **Parking Surveys:**

   i. On-Street Parking Studies
   ii. Off-Street Parking Studies

3. **Road Safety Auditing.**

References:

1. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal, Khanna, 2007.
2. Traffic Engineering and Transportation Planning, L.R.Kadiyali, Khanna Publications, 2007.
3. MX-Roads Software Manual

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I — Lecture Hrs:

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 — Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, 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 - III — Lecture Hrs:

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 - IV — Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V

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.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	HIGHWAY PROJECT FORMULATION & ECONOMICS	L	T	P	C
21D93201		3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students to:

- Understand the need & scope of Project Formulation.
- Understand the costs and savings involved in `Highway Projects
- Learn Economic Evaluation Methods of Highway Projects
- Understand the concepts of Accident Costs and Travel time Savings
- Learn todeal with Project Analysis for Environmental Impact Assessment.

Course Outcomes (CO): After completion of the course the student will be able to

- Understand the need & scope of Project Formulation.
- Understand the costs and savings involved in `Highway Projects
- Learn Economic Evaluation Methods of Highway Projects
- Understand the concepts of Accident Costs and Travel time Savings
- Learn todeal with Project Analysis for Environmental Impact Assessment.

UNIT - I — Lecture Hrs:10

Project Formulation: Requirements in ` Project Formulation, Components of Project, Non-Monetary and Monetary Criteria in ` Formulation of Project, Preparation of DPR – Guidelines.

Highway Projects and Economic Evaluation:
Need for Economic Evaluation; Principles of Economic Evaluation; Development of Cash Flow Diagrams, Cost and Benefit Components, Discounting Criteria.

UNIT - II — Lecture Hrs:10

Vehicle Operating Costs: Vehicle Operating Costs; Components of VOC, Factors Affecting VOC, Road User Cost Study in ` India, Factors Affecting Fuel Consumption-Relationships, Factors affecting Spare Parts Consumption.

UNIT - III — Lecture Hrs:10

Value of Travel Time Savings:
Economic Concept of Evaluation of Travel Time Savings; Issues Connected With Evaluation of Travel Time Savings,Methodologies Used for Evaluation of Travel Time-Wage Rate Approach, Revealed Preferences Approach.

UNIT - IV — Lecture Hrs:9

Accident Costs; Methodologies for Economic Evaluation of An Accident ; Factors Involved-Gross Output Approach, Net Output Approach, Life Insurance Approach, Court Award Approach, Implicit Public Sector Evaluation Approach, Value of Risk Change Approach, Issues in `Indian context.

UNIT - V — Lecture Hrs:9

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 toHighway Projects.

Textbooks:

1. Economic Analysis for Highways - Winfrey.R; International Text Book Company.
2. Traffic Engineering and Transport Planning - L.R Kadiyali, Khanna Publishers.
3. Road Project Appraisal, for Developing Countries, J.W.Dickey ,John Wiley & Sons.

Reference Books:

1. Road User Cost Study, CRRI
2. Fundamental of T.P. Engineering, by C.J. Chisty.
3. Transportation Engineering & Planning by C.S. Papacostas.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PAVEMENT CONSTRUCTION MAINTENANCE and MANAGEMENT	L	T	P	C
21D93202		3	0	0	3
	Semester	II			

Course Objectives: This Course has the following objectives:

- Introduce students to Pavement Management Systems
- Helps students to Understand Serviceability Concept and evaluation Methods
- Introduces to the students the Concepts of Quality Control and Assessment
- Gives the student the knowledge about construction of various components of Pavements like Sub-base, Base and shoulders
- Helps the students to learn the Design Concepts of Bituminous Roads and concrete Roads

Course Outcomes (CO): After completion of the course the student will be able to

- Understand the Pavement Management Systems
- Understand Serviceability Concept and evaluation Methods
- Learn the Concepts of Quality Control and Assessment
- Familiarize about construction of various components of Pavements like Sub-base, Base and shoulders
- Learn the Design Concepts of Bituminous Roads and concrete Roads

UNIT - I — Lecture Hrs:10

Pavement Management System:
Components of PMS and Their Activities; Major Steps in `Implementing PMS; Pavement Maintenance Management Components of Maintenance-Management and Related Activities.
Network and Project Level Analysis; Prioritization Techniques and Formulation of Maintenance Strategies.

UNIT - II — Lecture Hrs:10

Pavement Inventories and Evaluation : Serviceability Concepts ;Visual Rating ;Pavement Serviceability Index; Roughness Measurements ;Distress Modes – Cracking Rutting Etc; Pavement Deflection – Different Methods, Skid Resistance, Roughness, Safety – Aspects; Inventory System – Assessment of Deficiencies.

UNIT - III — Lecture Hrs:10

Pavement Maintenance and Quality Control : Causes of Deterioration, Traffic and Environmental Factors, Methods of Maintaining WBM, Bitumen and Cement Concrete Roads, Quality Assurance; Quality Control – ISO 9000 , Sampling Techniques – Tolerances and Controls Related to Profile and Compaction

UNIT - IV — Lecture Hrs:9

Construction of Base, Subbase and Shoulders :
Roadway and Drain Excavation, Excavation and Blasting, Embankment Construction, Construction of Gravel Base, Cement Stabilised Sub- Bases, WBM Bases, Wet Mix Construction; Crushed Cement Bases, Shoulder Construction;

UNIT - V — Lecture Hrs:9

Bituminous Pavement Construction and Cement Concrete Pavement Construction:
Preparation and Laying of Tack Coat; Bituminous Macadam ,Penetration Macadam, Built Up Spray Grout, Open Graded Premix, Mix Seal, Semi-Dense Asphalt Concrete-Interface Treatments and Overlay Construction, IRC Specifications, Introducing Mechanical Mixers, Pavers, Finishers.
Cement Concrete Pavement Analysis - Construction of Cement Roads, Manual and Mechanical Methods, Joints in ` Concrete and Reinforced Concrete Pavement and Overlay Construction –Related Equipment

Textbooks:

1. Pavement Management Systems- Haas and Hudson , W. R. –Mcgraw Hill Publications.
2. Pavements and Surfacing for Highways and Airports- Sargious, M. A. – Applied Science Publishers Ltd.

3. Highway and Traffic Engineering for Developing Countries- Bent Thagesan, 1996.

Reference Books:

1. Bridge and Pavement Maintenance- Transportation Research Record No.800, TRB.
2. Pavement Management for Airports, Roads and Parking Lots- Shahin M.Y, 1994.
3. MORTH - Specifications

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PAVEMENT ANALYSIS and DESIGN	L	T	P	C
21D93203a	(PE-III)	3	0	0	3
	Semester	II			

Course Objectives: This Course has the following objectives:

- Engineering analysis of stresses and strains in `typical highway pavement structures due to loading from traffic and climate; characterization of paving materials; structural pavement design by IRC, and AASHTO for flexible and rigid pavement are discussed.
- Overlay design for Flexible and Rigid pavement is discussed.

Course Outcomes (CO): After completion of the course the student will be able to

- Analyze the stresses and strains in `a flexible pavement using multi-layered elastic theory.
- Analyze stresses and strains in `a rigid pavement using Westergaard's theory.
- Design a Flexible pavement using IRC, Asphalt Institute, and AASHTO methods.
- Design a Rigid pavement using IRC, and AASHTO methods.
- Design of joints, dowel & tie bars.

UNIT - I — Lecture Hrs:10

Factors Affecting Pavement Design: Variables Considered in ` Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Axle Types of Rigid Chassis and Articulated Commercial Vehicles, Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure, Contact Pressure, EAL and ESWL Concepts, Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads.

UNIT - II — Lecture Hrs:10

Stresses in ` flexible and Rigid Pavements:
Stress Inducing Factors in ` Flexible and Rigid Pavements; Stress in ` Flexible Pavements: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two and Three Layered Systems, Fundamental Design Concepts;
Stresses in ` Rigid Pavements: Westergaard's Theory and Assumptions, Stresses Due toCurling, Stresses and Deflections Due toLoading, Frictional Stresses, Stresses in `Dowel Bars & Tie Bars

UNIT - III — Lecture Hrs:10

Materials and Characteristics:
CBR and Modulus of Subgrade Reaction of Soil, Mineral Aggregates – Blending of Aggregates, Binders, Polymer and Rubber Modified Bitumen, Fibre Reinforced Concrete,
Permanent Deformation Parameters and Other Properties, Effects and Methods of Stabilisation and Use of Geo Synthetics, Non Destructing Testing.

UNIT - IV — Lecture Hrs:9

Design of Flexible and Rigid Pavements: Development of Design Methods, Flexible Pavement Design Concepts, Asphalt Institute's Methods With HMA and Other Base Combinations, AASHTO, IRC Methods for Highways and Low Volume Roads, Design of Rigid Pavements: Calibrated Mechanistic Design Process, PCA, AASHTO & IRC Specifications, Rigid Pavement Design for Low Volume Rural Roads and Highways. Design of Overlays: Types & Design of Overlays: IRC Methods of Overlay Design, Importance of Profile Correction Course.

UNIT - V — Lecture Hrs:9

Airfield Pavement Design :
Aircraft Configurations, Flexible Airport Pavements - IS Specifications and Design, Corps of Engineers, FAA Methods, AI Methods.
Rigid Airport Pavements – IS Specifications, PCA Method, Corps of Engineers Method, FAA Method.

Textbooks:

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1. Design of Functional Pavements, Nai C. Yang, Mcgraw Hill Publications
2. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers
3. Pavement Analysis & Design, Yang H. Huang, Prentice Hall Inc.

Reference Books:

1. Principles of Pavement Design, Yoder.J. & Witzorac Mathew, W. John Wiley & Sons Inc
2. Pavement and Surfacings for Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.
3. IRC Codes for Flexible and Rigid Pavements Design

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ROAD SAFETY ENGINEERING	L	T	P	C
21D93203b	(PE- III)	3	0	0	3
	Semester	II			

Course Objectives: This Course has the following objectives:

- Discusses the fundamentals causes of road accidents & some of the statistical methods to analyze the traffic safety.
- The accident investigation and risk management are dealt.
- Introduction of Road Safety as an integral part of Road Design is emphasized.

Course Outcomes (CO): After completion of the course the student will be able

- To understand the basic causes of road accidents
- To conduct accident investigations and identify black spots
- To design & plan road geometrics incorporating road safety
- To understand the importance of Road Signs and Markings
- To conduct Road Safety Audit

UNIT - I — Lecture Hrs:10

Accident Investigations and Risk Management, Collection of Accident Data, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction, Condition and Collision Diagram.

UNIT - II — Lecture Hrs:10

Accident Investigations and Risk Management, Collection of Accident Data, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction, Condition and Collision Diagram.

UNIT - III — Lecture Hrs:10

Road Safety in ` Transport Planning and Geometric Design: Vehicle and Human Characteristics, Road Design and Safety Elements, Redesigning Junctions, Cross Section Improvements, Traffic Control, Traffic Calming Measures, Road Safety Furniture

UNIT - IV — Lecture Hrs:9

**Role of Signs and Markings in ` Safety**: Types of Signs – Design Specifications – Guidelines for Installation – Role of Signs in `Safety; Types of Road Markings – Design Specifications – Role of Road Markings in `Safety.

UNIT - V — Lecture Hrs:9

Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Road Safety Improvement Strategies, ITS and Safety.

Textbooks:

1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
3. Road Safety by NCHRP

Reference Books:

1. Transportation Engineering – An Introduction, C.Jotin Khisty, B. Kent Lall
2. Fundamentals of Traffic Engineering, Richardo G Sigua
3. Handbook of Road Safety Measures, Second Edition, Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	LAND USE and REGIONAL TRANSPORTATION PLANNING (PE-III)	L	T	P	C
21D93203c		3	0	0	3
	Semester	II			

Course Objectives: This Course has the following objectives:

- Introduces tothe fundamentals of Urban transportation planning.
- It familiarizes students with contemporary transportation planning issues and methods of analysis.
- The concepts of Regional Transportation Planning are introduced.
- Introduces the concepts of Regional Road Network Planning.

Course Outcomes (CO): After completion of the course the student will be able to

- Understand the fundamentals of Urban Regional Transportation Dynamics
- Understand the interrelationship between Landuse and Transport and todevelop models incorporating that relationship
- Understand Regional Trvel Demand modelling Concepts
- Learn the concepts of Regional Road Network Planning
- Understand Planning methods and Policies of Small Area Management and Neighbourhood Areas.

UNIT - I — Lecture Hrs:10

Urban Regional Dynamics: Population, Urbanisation and Migration, Urban Forms and Structures, Sector Theory, Urban Nodes, Multi Nuclei, Concept of Region, Hierarchy of Activities Issues Related toRegional Planning, Methods of Delineation Regions, Hierarchy of Regions, Findings of Commission on Urbanisation, Introduction toMicro Economic Theories of Landuse, Concepts by Van Thunan, Christaller and Losch.

UNIT - II — Lecture Hrs:10

Land use Transportation Models: Classification of LUT Models, Economic Base Mechanism, Allocation Mechanism and Spatial Allocation and Employment Relationships, Garin Lowry Models, Contribution by Putman and Wilson, Issues Related toLanduse Transport - Interaction, Case Study Examples.

UNIT - III — Lecture Hrs:10

Regional Travel Demand Estimation: Factors Affecting Goods and Passenger Flows, Use of Mathematical Models toEstimate Freight and Passenger Demand, Abstract Mode Models, Mode Specific Models, Direct Demand Models, IVF Models, IO Model, Case Studies, Truck Terminal Location – Planning.

UNIT - IV — Lecture Hrs:9

Regional Network Planning: Problems in `Developing Countries, Network Characteristics - Circuitry, Connectivity, Mobility, Accessibility and Level of Service Concepts - Network Structures and Indices – Network Planning – Evaluation - Graph Theory – Cut Sets – Flows & Traversing – Optimum Network - Inter-Modal Co-Ordination. Special Features of Low Volume Roads – Rural Road Network Planning.

UNIT - V — Lecture Hrs:9

Policy Formulation and Evaluation: Application of Landuse Forms and Structures At Urban and Regional Levels, Use of Multi-objective and Goal Programming Techniques, Small Area Management, Residential Neighbourhood and Structure Planning.

Textbooks:

1. Integrated Landuse and Transport Modelling: Decision Chains and Hierarchies,Barra, T. D., Cambridge University Press, 2005.
2. Urban Development Models, Baxter Et Al, Construction Press

3. The Land Use Transport System, Blundon, W. R. and J Black, 2nd Edition, Australian National University Press, 1984

Reference Books:

1. Bruton, M. J., An Introduction toTransportation Planning (The Living Environment), UCL Press, London, UK, 2000.
2. C.J. Khisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India Pvt. Ltd., 2002.
3. C.S. Papacostas and P.D. Prevedouros, Transportation Engineering and Planning, Prentice Hall of India Pvt. Ltd., 2001.
4. Chari, S. R., Landuse Transportation Planning, Lecture Notes, REC, Warangal, 1988
5. Dicky J.W., Metropolitan Transportation Planning, Script Book Co., Washington-D.C., 1975.
6. John D. Edwards, Transportation Planning Handbook, Second Edition, Institution of Transportation Engineers, 1999.
7. Wilson, A.G., Regional and Urban Models in `Geography and Planning, Pion Press.

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COURSE STRUCTURE & SYLLABI

Course Code	TRAFFIC ANALYSIS	L	T	P	C
21D93204a	(PE-IV)	3	0	0	3
	Semester	II			

Course Objectives: This Course has the following objectives:

- To focus on Traffic Measurements and Analysis using various theories of Statistics
- To give the knowledge of application of Statistical Distributions for Traffic Analysis
- To explain the use of queuing theory for Traffic Analysis
- To introduce the concept of Shockwave Theory and its use in `Traffic Analysis
- To make the student understand Pedestrian Delays and warrants associated with Pedestrian Control

Course Outcomes (CO): After completion of the course the student will be able to

- Understand Traffic Measurements and Analysis using various theories of Statistics
- Gin the knowledge of application of Statistical Distributions for Traffic Analysis
- Apply the M/M/1 and D/D/1 queuing theory concepts for Traffic Analysis
- Gain the knowledge of concept of Shockwave Theory and its use in `Traffic Analysis
- Understand Pedestrian Delays and warrants associated with Pedestrian Control

UNIT - I — Lecture Hrs:10

Traffic Flow Description: Types of Statistical Distributions; Discrete and Continuous Distributions; Counting and Interval Distributions Used in ` Traffic Analysis; Poisson's Distribution for Vehicle Arrivals; Headway Distributions – Exponential Distribution; Shifted Exponential Distribution; Erlang Distribution; Composite Distribution. Numerical Exercises.

UNIT - II — Lecture Hrs:10

Queuing Theory :M/M/1 & D/D/I System:
Introduction to Queuing Theory; Notation Used for Describing A Queue System; Analysis of M/M/1 System; Assumptions and Derivation of System State Equations; Application of M/M/1 Analysis for Parking Garages and Toll Plazas- Numerical Examples.
Queuing Theory - D/D/1 System: Traffic Interruptions Like Accidents Or Bottlenecks; 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 - III — Lecture Hrs:10

Pedestrian Delays and Gaps: Pedestrian Gap Acceptance and Delays; Concept of Blocks, Anti-Blocks, Gaps and Non-Gaps; Underwood's Analysis for Pedestrian Delays; Warrants for Pedestrian Crossing Facilities – Minimum Vehicular Volume Warrant, Minimum Pedestrian Volume Warrant, Maximum Pedestrian Volume Warrant;

UNIT - IV — Lecture Hrs:9

Shockwave Theory: Concept of Shockwave; Causes for Traffic Interruptions and Shockwaves; 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;

UNIT - V — Lecture Hrs:9

Traffic Simulation:
Introduction to Simulation; Need for Simulation Modelling; Steps in `Simulation; Interval Oriented and Event Oriented Simulation; Use of Random Numbers in `Simulation; Random Number Generation Methods; Computing Headways and Arrival Times Based on Random Numbers;
Basic Concepts of Simulation Modelling Application for Signalised Intersections, Pedestrian Crossings and Transit Scheduling.

Textbooks:

1. Traffic Flow Theory: A Monograph , TRB Special Report 165
2. Fundamentals of Transportation Engineering – C.S.Papacostas, Prentice Hall India Publication

Reference Books:
1. Principles of Highway Engineering and Traffic Analysis – F.L.Mannering & W.P.Kilareski, John Wiley Publishers. 2. Traffic Flow Fundamentals – A.D.May, , Prentice Hall India Publication 3. Fundamentals of Traffic Engineering – Mcshane & Rogers

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	APPLIED STATISTICS	L	T	P	C
21DBS201	(PEC-IV)	3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To impart knowledge in basic concepts and few techniques in probability and statistics in various applications in engineering
- To impart knowledge in correlation and regression and time series analysis.

Course Outcomes (CO): Student will be able to

- Familiarize with the concepts of sampling techniques.
- Explain the statistical distributions
- Analyse the correlation coefficient and regression.
- Explain the concepts of time series.
- Apply the concept of hypothesis testing for large as well as small samples.

UNIT - I — Lecture Hrs:8

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 — Lecture Hrs:8

Probability and Statistical Distributions: Laws of probability; Conditional probability and Independent events; Laws of expectation.
Binomial, Poisson, Exponential and Normal distributions; Moments of random variable: Fitting of distributions.

UNIT - III — Lecture Hrs:

Regression and Correlation: Linear regression and Correlation; Multiple correlation coefficient; Standard error of estimate; Curvilinear regression; Applications in transportation engineering.

UNIT - IV — Lecture Hrs:8

Tests of Hypotheses & Confidence Interval – Large Samples, Tests for single mean, Means of two samples, Proportions, Two variances, Two observed correlation coefficients,

UNIT - V — Lecture Hrs:8

Small sample tests: Tests of significance & confidence interval-Intervals for mean, Variance and Regression coefficients; Chi-square distribution; Students t-distribution; Paired t-tests, F-distribution; Chi-Square Test of Goodness-of-Fit. Applications In traffic engineering problems.

Textbooks:

1. Basic Statistics - Simpson And Kafks; Oxford And IBH Calcutta, 1969.
2. Fundamentals of Mathematical Statistics – Gupta, S.C And Kapoor, K.V.Sultanchand.

Reference Books:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008
2. Multivariate Data Analysis –Cootey W.W & Cohens P.R;John Wiley &Sons.

Online Learning Resources:

After completion of this course the student should be able to :

- explain the concepts of probability and their applications
- apply discrete and continuous probability distributions in practical problems
- use the statistical inferential methods based on small and large sampling tests

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	GIS APPLICATIONS in `TRANSPORTATION ENGINEERING (PE– IV)	L	T	P	C
21D93204B		3	0	0	3
	Semester	II			

Course Objectives: This Course has the following objectives:

- To introduce the basics of GIS.
- To explain the Geographic Data collection.
- To make the student tolearn the GIS Data Processing, Analysis and Modelling.
- To make the student tolearn about application of GIS in `Transportation Engineering.

Course Outcomes (CO): After completion of the course the student will be able to

- Understand the basics of GIS
- Understand the Geographic Data and its collection.
- Able to Process and analyse GIS data.
- Able to use GIS Tool for developing alternative Transportation Plans
- Understand the applications of GIS in `Transportation Engineering.

UNIT - I — Lecture Hrs:10

Introduction to GIS and Data Input & Output:
Introduction, GIS Over View, Use of GIS in `Decision Making, Data Processing, Components of GIS, The GIS and The Organization.
Data Input and Output - Data Input - Key Board Entry, Manual Digitizing, Scanning, Remotely and Sensed Data, Existing Digital Data, Census Related Data Sets, Data Output - Hard Copy and Soft, Copy Devices.

UNIT - II — Lecture Hrs:10

Data Quality and Management :
Components of Data Quality - Micro Level, Macro Level Components, Sources of Error, Data Accuracy; Data Management - The Data Base Approach, 3 Classic Data Models, Nature of Geographic Data, Spatial Data Models, Databases for GIS.

UNIT - III — Lecture Hrs:10

GIS Analysis and Functions: Organizing Geographic Data for Analysis, Maintenance and Analysis of The Spatial Data and Non-Spatial Attribute Data and Its Integration Output Formatting.

UNIT - IV — Lecture Hrs:9

Implementing a GIS: Awareness, Developing System Requirements, Evaluation of Alternative Systems, System Justification and Development of An Implementation Plan, System Acquisition and Start Up, Operation of The System.

UNIT - V — Lecture Hrs:9

Application of GIS in `Transportation Engineering :
Intelligent Information System for Road Accessibility Study, GIS Data Base Design for Physical Facility Planning, Decision Support Systems for Land Use Planning. GIS Applications in `Environment Impact Assessment.
GIS Basedased Highway Alignment, GIS Based Road Network Planning, GIS Based Traffic Congestion Analysis and Accident Investigation.

Textbooks:

1. Principles of Geographical Information Systems, Burrough, P.A., Oxford Publication
2. GIS for Urban & Regional Planning, Scholten & Stillwen, 1990, Kulwer Academic Publisher.
3. GIS A Management, Perspenfi Stan Aronoff, WDL Publisher.

Reference Books:

1. Concepts and Techniques of Geographic Information Systems, Lo, C.P. & Yeung A.K.W., Prentice Hall of India, New Delhi.

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COURSE STRUCTURE & SYLLABI

2. Getting Started with Geographic Information Systems, Clarke, K., Prentice Hall, New Jersy.
3. Fundamentals of Geographic Information Systems, DeMers, M.N., John Wiley & Sons, New York.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED PAVEMENT ENGINEERING LAB	L	T	P	C
21D93205		0	0	4	2
	Semester	II			

Course Objectives: This Course has the following objectives:

- The various assessment techniques of the pavement are taught
- The mix design of pavement is taught
- Visual analysis and other pavement characteristics are taught

Course Outcomes (CO): After completion of the course the student will be able to

- Design and assess various pavement components
- Analyze pavement failures and their characteristics

List of Experiments:

1. Mix Design of Pavement
2. Deflection Assessment on Pavement
3. Density Assessment on Pavement
4. Surface Condition Assessment
5. Visual Condition Analysis of Pavement
6. Pavement Failure-Analysis
7. Impact of Road Geometric on Skid Resistance
8. Material and Deficient Pavement Layers and its Impact on Pavement Performance.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	TRAFFIC ANALYSISAND SOFTWARE LAB	L	T	P	C
21D93206		0	0	4	2
	Semester	II			

Course Objectives: This Course has the following objectives:

- The various characteristics of the road network.
- Parking and congestion pavements.
- Road safety analysis methods and importance of ITS.

Course Outcomes (CO): After completion of the course the student will be able to

- Apply Software Tools like MX Roads and VISSIM for Traffic Analysis
- Conduct Road Safety Audit.
- Analyse Bottleneck Situations in `the real field

List of Experiments:

1. Using MX Roads for Intersection Design
2. Using MX Roads for Geometric Design of Curves
3. Using VISSIM FOR Signalized Intersection Simulation
4. Using VISSIM for Pedestrian Movement Simulation
5. Understanding ITS and Developing Prototype Models
6. Road Safety Audit
7. Analysis of Bottlenecks in `the field applying Shockwave Theory
8. Congestion Modelling of Real Time Data

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ENVIRONMENTAL IMPACT ASSESSMENT for TRANSPORTATION PROJECTS (Elective - V)	L	T	P	C
21D93301a		3	0	0	3
	Semester	III			

Course Objectives: This Course has the following objectives:

- To explain the relation between Human Activities and Environment
- To familiarize students with various indicators of different Environmental systems
- To introduce the concepts of Environmental Impact assessment of Transportation Projects
- To discuss the issues related toIndustrial Development and Environmental Impact

Course Outcomes (CO): After completion of the course the student will be able to

- Understand the relation between Human Activities and Environment
- Get acquainted with various indicators of different Environmental systems
- Learn the concepts of Environmental Impact assessment of Transportation Projects
- Apply the concepts of EIA to actual case studies
- Understand the issues related to Industrial Development and Environmental Impact

UNIT - I — Lecture Hrs:10

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 — Lecture Hrs:10

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 — Lecture Hrs:10

Environmental Impact Assessment for Transportation Projects: Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety & Capacity Impacts– Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical Case Studies

UNIT - IV — Lecture Hrs:9

Environmental Issues in ` Industrial Development: On-Site and Off-Site Impacts During Various Stages of Industrial Development, Long Term Climatic Changes, Green House Effect, Industrial Effluents and Their Impact on Natural Cycle, Environmental Impact of Highways, Mining and Energy Development

UNIT - V — Lecture Hrs:9

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

Textbooks:

1. Jain, R.K., Urban, L.V., Stracy, G.S., (1991), "Environmental Impact Analysis", Van Nostrand Reinhold Co., New York
2. Rau, J.G. and Wooten, D.C., (1996), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York

Reference Books:

1. UNESCO, (1987), "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", UNESCO/UNEP, Paris
2. Canter, L.W., (1997), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	TRANSPORTATION SYSTEM MANAGEMENT	L	T	P	C
21D93301b	(PE-V)	3	0	0	3
	Semester	III			

Course Objectives: This Course has the following objectives:

- Discusses the systems approach of transportation planning
- Discusses various measures related to TSM
- Describes the Management of Transit and Para-Transit
- Discusses the measure to promote non-auto modes

Course Outcomes (CO): After completion of the course the student will be able to

- Understand the Concept of TSM and the philosophy of Systems Approach
- Understand the types of TSM strategies for reducing Congestion on Urban Roads
- Comprehends the Importance of Parking and its management
- Understand the Management of Transit and Para-transit
- Understand the need for promoting Non-auto modes

UNIT - I — Lecture Hrs:10

TSM Philosophy: Systems Approach to Transportation Planning; Long Term Strategies and Short Term Measures; TSM Actions – Objectives and Philosophy; Relevance of TSM Actions to Indian Urban Context. Broad Spectrum of TSM Actions.

UNIT - II — Lecture Hrs:10

Traffic Management Measures I: Measures for Improving Vehicular Flow – One Way Streets-Advantages and Disadvantages- Guidelines for Implementation;, Signal Improvements, Transit Stop Relocation, Parking Management.

UNIT - III — Lecture Hrs:10

Traffic Management Measures II: Reversible Lanes-Guidelines for Applicability; Reducing Peak Period Traffic – Staggering of Working Hours-Different Methods;, Congestion Pricing- Methods-Differential Toll Policies Differential Parking Fee policy.

UNIT - IV — Lecture Hrs:9

Measures to Promote Transit and Non-Auto Modes:
Preferential Treatment to High Occupancy Vehicles; Car Pooling; Transit Service Improvement Measures; Transit Management Improvement Measures; Transit and Para Transit Integration; Para-Transit Role in ` Urban Areas; Multi-Modal Coordination.
Measures to Promote Non-Auto Modes - Pedestrianisation; Bicycle Transportation – Advantages; Planning Bicycle Facilities – Class I, Class II and Class III Bikeways; Junction Treatments for Cycle Tracks.

UNIT - V — Lecture Hrs:9

Bus Route Network Planning ,Management and Evaluation:
Types of Bus Route Net Works; Suitability for A Given Urban Area; Types of Routes – Corridor Routes, Activity Routes and Residential Routes; Issues in ` Route Network Evaluation – Number of Routes, Length of Routes; Route Alignment Methods; Service Coverage and Accessibility Index.

Textbooks:

1. Transportation System Management Notes, S.R.Chari, Rec, Warangal
2. Metropolitan Transportation Planning, John W Dickey, Tata Mcgraw Hill

Reference Books:

1. The Bicycle Planning, Mike Hudson, Open Books, Uk
2. Transportation Engineering– An Introduction – C.Jotin Khisty& B. Kent Lall, Prentice Hall.
3. Traffic and Highway Engineering – Nicholas J.Garber and Lester A. Hoel, Cengage Learning, USA, 2009.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	INTELLIGENT TRANSPORTATION SYSTEMS	L	T	P	C
21D93301c	(PE-V)	3	0	0	3
	Semester	III			

Course Objectives: This Course has the following objectives:

- Introduces the students toIntelligent Transportation Systems
- Makes them understand the Architecture of ITS
- Makes them understand the working of systems like ATMS,APTS,ETC,CVO etc.
- Familiarize them with examples of ITS applications

Course Outcomes (CO): After completion of the course the student will be able to

- Understand ITS & ATIS
- Explain about Advanced Transportation Management System
- Know about APTS, CVO, new technology and ETC
- Details about regional architecture, integration of infrastructure and operational planning
- Summarizes about ITS issues in `terms of various factors and emerging issues.

UNIT - I	Lecture Hrs:10

Introduction toITS, including where ITS fits; roles and responsibilities Advanced Traveller Information Systems (ATIS), including functionality; business models; field trip toSmart Route Systems.

UNIT - II	Lecture Hrs:10

Advanced Transportation Management Systems (ATMS), including network operations; incident detection; congestion pricing, tolling, HOT lanes, example deployments

UNIT - III	Lecture Hrs:10

Fleet-oriented ITS services, including Advanced Public Transportation Systems (APTS); BRT; Commercial Vehicle Operations (CVO); Intermodal Freight , including International Operations and Supply Chains ITS and Technology, including automated highway systems (AHS); sensors, electronic toll collection (ETC); dedicated short range communication ,and standards

UNIT - IV	Lecture Hrs:9

Regionally-scaled ITS deployment, including regional architecture; organizational an d institutional issues; standards; developed vs. developing countries; ITS and strategic regional transportation planning; Integrating infrastructure and operations planning

UNIT - V	Lecture Hrs:9

Critical ITS Issues, including (as time permits) ITS and security; safety; human factors; privacy; sustainability; funding (as contrasted with conventional infrastructure); technology deployment/R &D/policy; other institutional issues Conclusion, including regional ITS planning and architecture presentation; the future of ITS; International ITS Programs Case Studies: applications in `bus transport, metro and highways; Emerging Issues.

Textbooks:

1. Intelligent Transportation Systems: New Principles and Architectures, Ghosh, S., Lee, T.S. CRC Press, 2000.
2. Fundamentals of Intelligent Transportation Systems Planning, Mashrur A. Chowdhury, and Adel Sadek, Artech House, Inc., 2003.
3. Traffic Engineering, R.P Roess, E.S. Prassas, W.R. McShane. Pearson Educational International, Third Edition, 2004.

Reference Books:

1. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

AUDIT COURSE-I

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I	Lecture Hrs:10
1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity	
UNIT - II	Lecture Hrs:10
Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization	
UNIT - III	Lecture Hrs:10
Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.	
UNIT - IV	Lecture Hrs:9
Key skills needed for writing a Title, Abstract, and Introduction	
UNIT - V	Lecture Hrs:9
Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions	

Suggested Reading

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

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT - II

Repercussions of Disasters and Hazards:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHa

ll OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I		
Alphabets in Sanskrit,		
UNIT - II		
Past/Present/Future Tense, Simple Sentences		
UNIT - III		
Order, Introduction of roots		
UNIT - IV		
Technical information about Sanskrit Literature		
UNIT - V		
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics		

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

AUDIT COURSE-II

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation

research project (MUSTER) country report 1. London: DFID.

5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I		
Definitions of Eight parts of yog.(Ashtanga)		
UNIT - II		
Yam and Niyam.		
UNIT - III		
Do`sand Don't'sin life. i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan		
UNIT - IV		
Asan and Pranayam		
UNIT - V		
i)Variousyogposesand theirbenefitsformind &body ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam		

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1."SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

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OPEN ELECTIVE

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
21DOE301a		3	0	0	3
	Semester	I			

Course Objectives:

- To explain cost concepts and objectives of costing system and cost management process
- To provide knowledge and explain Cost behaviour in relation to Volume and Profit and pricing decisions.
- To know the concepts of target costing, life cycle costing and activity based cost management in a project or business.
- To discuss on budget and budgetary control , type of budgets in a business to control costs
- To provide knowledge on project, types of projects, stages of project execution, types of project contracts and project cost control.

Course Outcomes (CO): Student will be able to

- Know the cost management process and types of costs
- Learn and apply different costing methods under different project contracts
- To understand relationship of Cost-Volume and Profit and pricing decisions.
- Prepare budgets and measurement of divisional performance.
- Acquires knowledge on various types of project contracts, stages to execute projects and controlling project cost..

UNIT - I		Lecture Hrs:10

Introduction and Overview of the Strategic Cost Management Process - Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT - II		Lecture Hrs:12

Cost Behavior and Profit Planning: Marginal Costing- Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems; Pareto Analysis Just-in-time approach, Theory of constraints.; Divisional performance management: - Measurement of Divisional profitability - pricing decisions - transfer pricing.

UNIT - III		Lecture Hrs:10

Target costing- Life Cycle Costing - Activity-Based Cost management:- Activity based costing- Value-Chain Analysis- Bench Marking; Balanced Score Card.

UNIT - IV		Lecture Hrs:10

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT - V		Lecture Hrs:12

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Textbooks:

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler

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publisher
Reference Books:
1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi 2. Charles T. Horngren and George Foster, Advanced Management Accounting 3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd
Online Learning Resources:
https://nptel.ac.in/courses/105/104/105104161/ https://nptel.ac.in/courses/112/102/112102106/

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	INDUSTRIAL SAFETY	L	T	P	C
21DOE301b		3	0	0	3
	Semester	III			

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazards and its risk assessment.

Course Outcomes (CO): Student will be able to

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.

UNIT - I — Lecture Hrs:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II — Lecture Hrs:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT - III — Lecture Hrs:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working andapplications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV — Lecture Hrs:

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V — Lecture Hrs:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

1.Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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M.TECH. IN HIGH WAY ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	OPERATIONS RESEARCH	L	T	P	C
21DOE301d		3	0	0	3
	Semester	III			

Course Objectives:

- To impart knowledge in concepts and tools of Operations Research
- To understand mathematical models used in Operations Research
- To apply these techniques constructively to make effective business decisions

Course Outcomes (CO): Student will be able to

- Solve Linear Programming Problems
- Solve Transportation and Assignment Problems
- Understand the usage of game theory and Simulation for Solving Business Problems

UNIT - I Lecture Hrs:

Linear programming problems - Mathematical formulation, graphical method of solution, simplex method

UNIT - II Lecture Hrs:

Duality in linear programming problems, dual simplex method, sensitivity analysis, transportation and assignment problems, Traveling salesman Problem.

UNIT - III Lecture Hrs:

Game theory Introduction, two-person zero-sum games, some basic terms, the maxmin principle, games without saddle points-Mixed Strategies, graphic solution of 2 * n and m*2 games, dominance property. CPM & PERT- project scheduling, critical path calculations, Crashing.

UNIT - IV Lecture Hrs:

Queuing theory -basic structure of queuing systems, roles of the Poisson and exponential distributions, classification of queues basic results of M/M/1: FIFO systems, Extension to multi-server queues.

UNIT - V

Simulation: simulation concepts, simulation of a queuing system using event list, pseudorandom numbers, multiplication congruential algorithm, inverse transformation method, basic ideas of Monte-Carlo simulation.

Text Books:

1. Taha.H.A ,operation Research : An Introduction, McMilan publishing Co., 1982. 7th ed.
2. Ravindran A, Philips D.T &Solbery.J.J, Operations Research: Principles and practice, John Wiley & Sons, New York, 1987.
3. Frank S. Budnick, Dennis Mcleavey and Richard Mojena, Principles of Operations Research for Management. All India Traveler Book seller, Delhi.
4. Gillet.B.E., Introduction to Operations Research - A Computer oriented algorithmic approach, McGraw Hill, 1987.
5. Joseph.G.Ecker& Michael KupperSchimd, Introduction to operations Research, John Wiley & Sons, 1988.
6. Hillier.F.S&Liberman.G.J, operation Research, Second Edition, Holden Day
   a. Inc, 1974.
7. KantiSwarup, Gupta.P.K. & Man Mohan, operations Research, S.Chand& Sons.