

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure and syllabi for M.Tech-CIVIL HIGHWAY ENGINEERING for affiliated Engineering Colleges 2017-18

I YEAR I Semester

S. No	Course Code	Subject	L	T	P	C
1.	17D93101	Highway Infrastructure Design	4	---	---	4
2.	17D93102	Urban Transportation Planning	4	---	---	4
3.	17D93103	Traffic Engineering	4	---	---	4
4.	17D93104	Pavement Materials And Properties	4	---	---	4
5.	17D93105 17D93106 17D93107	Elective – I 1. Applied Statistics 2. Project Management 3. Bridge Engineering	4	---	---	4
6.	17D93108 17D93109 17D20106	Elective – II 1. Remote Sensing & Global Positioning Systems 2. Ground Improvement Methods 3. Advanced Concrete Technology	4	---	---	4
7.	17D93110	Highway Engineering Lab	--	---	4	2
Total			24		4	26

I YEAR II Semester

S. No	Course Code	Subject	L	T	P	C
1.	17D93201	Highway Project Formulation And Economics	4	---	---	4
2.	17D93202	Pavement Construction, Maintenance & Management	4	---	---	4
3.	17D93203	Pavement Analysis And Design	4	---	---	4
4.	17D93204	Traffic Analysis	4	---	---	4
5.	17D93205 17D93206 17D93207	Elective – III 1. Road Safety Engineering 2. Land Use And Transportation Modeling 3. Transportation System Management	4	---	---	4
6.	17D93208 17D93209 17D93210	Elective – Iv 1. Environmental Impact Assessment For Transportation Projects 2. GIS Applications In Transportation Engineering 3. Optimization Techniques	4	---	---	4
7.	17D93211	Traffic Engineering Lab	--	---	4	2
Total			24		4	26

M.Tech. II YEAR (III Semester)

S. No	Course Code	Subject	L	T	P	C
1.	17D20301 17D20302 17D20303	Elective – V (Open Elective) 1. Research Methodology 2. Human Values & Professional Ethics 3. Intellectual Property Rights	4	---	---	4
2.	17D93301	ELECTIVE – VI (MOOCs)	--	---	---	--
3.	17D93302	Comprehensive Viva Voce	--	---	---	2
4.	17D93303	Seminar	--	---	---	2
5.	17D93304	Teaching Assignment	--	---	---	2
6.	17D93305	Project Work Phase I	--	---	---	4
	Total		4			14

M.Tech. II YEAR (IV Semester)

S. No	Course Code	Subject	L	T	P	C
1.	17D93401	Project Work Phase II	--	---	---	12
	Total					12

Project Viva Voce Grades:
A: Satisfactory
B: Not Satisfactory

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M.Tech I semester (HE)

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(17D93101) HIGHWAY INFRASTRUCTURE DESIGN

UNIT-I:

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:

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:

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:

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:

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 .

REFERENCES:

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
3. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
4. IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas.

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(17D93102) URBAN TRANSPORTATION PLANNING

UNIT-I:

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:

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:

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:

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:

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.

REFERENCES:

1. Introduction To Transportation Planning By C.J. Chisty.
2. Transportation Engineering & Planning By C.S. Papacostas.
3. Traffic Engineering And Transport Planning - Kadiyali L.R., Khanna Publishers
4. Lecture Notes On UTP - Prof. S. Raghavachari , R.E.C.Warangal.

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(17D93103) TRAFFIC ENGINEERING

UNIT-I:

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:

Highway Capacity And Level Of Service: Basic Definitions Related To Capacity; Level Of Service Concept; Factors Affecting Capacity And Level Of Service; Computation Of Capacity And Level Of Service For Two Lane Highways, Multilane Highways And Freeways. Numerical Exercises.

UNIT-III:

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:

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:

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.

REFERENCES:

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. Transportation Engineering - An Introduction - C.Jotin Khisty, Prentice Hall Publication.
4. Fundamentals Of Transportation Engineering - C.S.Papacostas, Prentice Hall India.

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(17D93104) PAVEMENT MATERIALS AND PROPERTIES

UNIT-I:

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:

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:

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 To Emulsified Bitumen And Its Characterization; Desirable Properties Of Bituminous Mixes, Design Of Bituminous Mixes: Modified Marshall's Specifications, Introduction To Super Pave Mix Design Procedure.

UNIT-IV:

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:

Introduction To Advanced Concretes Like 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 .

REFERENCES:

1. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice-Hall.
2. Kerbs Robert D. and Richard D. Walker, Highway Materials, McGraw-Hill, 1971.
3. Relevant IRC and IS Codes of Practices.
4. Read, J. And Whiteoak, D., "*The Shell Bitumen Handbook*", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London 2003.

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(17D93105) APPLIED STATISTICS
(ELECTIVE - I)

UNIT-I:

Introduction & Sampling Techniques: Frequency Distribution; Mean; Standard Deviation; Standard Error, Skewness; Kurtosis; Definitions And Applications; Simple Random Sampling; Stratified Sampling; Systematic Sampling; Sample Size Determination; Applications In Traffic Engineering,

UNIT-II:

Statistical Distributions And Probability: Binomial, Poisson, Exponential And Normal Distributions; Moments Of Random Variable: Fitting Of Distributions: Chi-Square Test Of Goodness-Of-Fit; Applications In Traffic Engineering. Probability.

Laws Of Probability; Conditional Probability And Independent Events; Laws Of Expectation.

UNIT-III:

Regression And Correlation: Linear Regression And Correlation; Multiple Correlation Coefficient; Standard Error Of Estimate; Analysis Of Variance; Curvilinear Regression; Applications In Transportation Engineering.

UNIT-IV:

Principal component analysis; Time series analysis. Exact Sampling Distributions – Chi-square distribution; Students t-distribution; F-distribution; Numerical Examples in Transportation Engineering.

UNIT-V:

Tests Of Significance & Confidence Interval – Large Sample And Small Sample Tests; Tests For Single Mean, Means Of Two Samples, Proportions, Two Variances, Two Observed Correlation Coefficients, Paired T-Tests, Applications.

Tests Of Significance & Confidence Interval-Intervals For Mean, Variance And Regression Coefficients; Applications In Traffic Engineering Problems.

REFERENCES:

1. Basic Statistics - Simpson And Kafks; Oxford And IBH Calcutta, 1969.

2. Fundamentals Of Mathematical Statistics – Gupta, S.C And Kapoor, K.V.Sultanchand.
3. Multivariate Data Analysis –Cootey W.W & Cohens P.R;John Wiley &Sons.

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(17D93106) PROJECT MANAGEMENT
ELECTIVE - I

UNIT-I:

Introduction to Project Management: A systems Approach, Systems Theory and 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:

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:

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:

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

UNIT-V:

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.

REFERENCES:

1. Herold Kerzner - Project Management - A systems approach to Planning, Scheduling and Controlling. CBS Publishers and Distributors.
2. K.Waker A Teraih and Jose M.Grevan; Fundamentals of Construction Management and Organisations.
3. Anghel Patterson - Construction Cost Engineering Handbook - Marcel Dekken Inc.
4. Dell Isola - Value Engineering in Construction Industry, Van Nostrand Reinhold Co.,
5. Choudhary, S. Project Management, Tata McGraw Hill Publishing Co., Ltd.,
6. Raina UK, Construction management Practices, Tata McGraw-Hill Publishing Company Ltd. Sengupta B and Guha H, Construction Management and Planning, Tata McGraw-Hill Publishing Company Limited, New Delhi.

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(17D93107) BRIDGE ENGINEERING
(Elective - I)

UNIT-I:

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:

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:

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

UNIT-IV:

General Design requirements-Mild steel reinforcement in prestressed 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:

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.

REFERENCES:

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. Concrete Bridge Design and Practice by V.K.Raina.
4. Prestressed Concrete bridges by N. Krihnam Raju
5. Prestress Concrete – A fundamental Approach. Edward Navy

Note: This subject must be taught by M-Tech. Structural Engineering, faculty only

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(17D93108) REMOTE SENSING & GLOBAL POSITIONING SYSTEMS
(Elective – II)

UNIT-I:

Remote Sensing Technology : Basic Principles – Introduction, Electromagnetic And Its Properties, Interaction With Earth Surface Materials, Recent Developments In Remote Sensing, Social And Legal Implications Of Remote Sensing, Status Of Remote Sensing.

Remote Sensing. Platforms & Sensors - Introduction, Characteristics Of Imaging Remote Sensing Instruments, Satellite Remote Sensing System – A Brief Over View , Other Remote Sensing Satellites.

UNIT-II:

Pre-Processing And Enhancement Techniques For Remotely Sensed Data: Introduction, Cosmetic Operation; Geometric Connection And Registration, Atmospheric Correction.

UNIT-III:

Enhancement Technique - Introduction, Human Visual System, Contrast Enhancement; Pseudo Color Enhancement.

Image Transforms: Introduction, Arithmetic Operations, Empirically Based Image Transforms, Principal Component Analysis , Multiple Discriminant Analysis Etc.

UNIT-IV:

Filtering Technique Classification: Low-Pass (Smoothing Filters) High Pass (Sharpening) Filters, Edge Detection, Frequency Domain Filters.

Geometrical Basis, Classification, Unsupervised And Supervised Classification, Classification Accuracy.

UNIT-V:

G.P.S.: Introduction, Elements Of Satellite Surveying, Eglobal Positioning System, Gps Satellites, Adjustment Computations, Gps Observables, Application Of Gps Technology In Highway Alignment, Network Planning.

REFERENCES:

1. GPS Satellite Surveys, Alfred Leick , Willey & Sons
2. Principles of Remote Sensing , Paul Juman, ELBS , 1985.
3. Computer Processing of Remotely sensed Images An Introduction – Paul M.Mather, John Wiley & Sons 1989.

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(17D93109) GROUND IMPROVEMENT METHODS
(ELECTIVE – II)

UNIT-I:

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:

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

UNIT-III:

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:

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:

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.

REFERENCES:

1. Hausmann, M. R. (1990) – Engineering Principles Of Ground Modifications, McGraw Hill Publications
2. M. P. Moseley And K. Krisch (2006) – Ground Improvement, II Edition, Taylor And Francis
3. Koerner, R. M (1994) – Designing With Geosynthetics – Prentice Hall, New Jersey
4. Jones C. J.F.P. (1985) – Earth Reinforcement And Soil Structures –

Butterworths, London.

5. Xianthakos, Abreimson And Bruce - Ground Control And Improvement
6. K. Krisch & F. Krisch (2010) - Ground Improvement by Deep Vibratory Methods, Spon Press, Taylor and Francis
7. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012.

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(17D20106) ADVANCED CONCRETE TECHNOLOGY

1. **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.
2. **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.
3. **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.
4. **Elasticity, Shrinkage And Creep:** Modulus Of Elasticity – Dynamic Modulus Of Elasticity – Poisson's Ratio – Early Volume Changes – Swelling – Drying 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.

5. **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 –Light Weight Aggregate Concrete- Cellular Concrete - No Fines Concrete – High Density Concrete – Fiber Reinforced Concrete – Different Types Of Fibers - Factors Affecting Properties Of FRC – Applications Polymer Concrete – Types Of Polymer Concrete Properties Of Polymer Concrete and Applications

TEXT/ REFERENCE BOOKS:

1. Properties Of Concrete By A.M.Neville – Pearson Publication – 4th Edition
2. Concrete Technology By M.S.Shetty. – S.Chand & Co. ; 2004
3. Design Of Concrete Mix By Krishna Raju, CBS Publishers.
4. Concrete: Micro Structure, Properties And Materials – P.K.Mehta And J.M.Monteiro, Mc-Graw Hill Publishers
5. Concrete Technology By A.R. Santha Kumar, Oxford University Press, New Delhi
6. Concrete Technology By A.M.Neville – Pearson Publication
7. Concrete Technology By M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
8. Non-Destructive Test And Evaluation Of Materials By J.Prasad & C.G.K. Nair , Tata Mcgraw Hill Publishers, New Delhi

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(17D93110) HIGHWAY ENGINEERING LAB.

- 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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(17D93201) HIGHWAY PROJECT FORMULATION & ECONOMICS

UNIT I:

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:

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:

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:

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 IV:

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 To Highway Projects.

REFERENCES:

1. Economic Analysis for Highways - Winfrey.R; International Text Book Company.
2. Traffic Engineering and Transport Planning - L.R Kadiyali, Khanna Publishers.
3. Road User Cost Study, CRRI
4. Road Project Appraisal, for Developing Countries, J.W.Dickey ,John Wiley & Sons.
5. Fundamental of T.P. Engineering, by C.J. Chisty.
6. Transportation Engineering & Planning by C.S. Papacostas.

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(17D93202) PAVEMENT CONSTRUCTION MAINTENANCE AND MANAGEMENT

Unit I:

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:

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:

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:

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:

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

REFERENCES:

1. Haas And Hudson , W. R. Pavement Management Systems –Mcgraw Hill Publications.
2. Sargious, M. A. – Pavements And Surfacing For Highways And Airports – Applied Science Publishers Ltd.
3. Bridge And Pavement Maintenance- Transportation Research Record No.800, TRB.
4. Shahin M.Y, 1994- Pavement Management For Airports, Roads And Parking Lots.
5. Bent Thagesan, 1996- Highway And Traffic Engineering For Developing Countries.

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(17D93203) PAVEMENT ANALYSIS AND DESIGN

Unit I:

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:

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 To Curling, Stresses And Deflections Due To Loading, Frictional Stresses, Stresses In Dowel Bars & Tie Bars

Unit III:

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 :

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:**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.

REFERENCES:

1. Design Of Functional Pavements, Nai C. Yang, Mcgraw Hill Publications
2. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers
3. Principles Of Pavement Design, Yoder.J. & Witzorac Mathew, W. John Wiley & Sons Inc
4. Pavement Analysis & Design, Yang H. Huang, Prentice Hall Inc.
5. Pavement And Surfacing For Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.
6. IRC Codes For Flexible And Rigid Pavements Design

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(17D93204) TRAFFIC ANALYSIS

UNIT-I:

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:

Queueing Theory: M/M/1 & D/D/1 System:

Introduction To Queueing 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.

Queueing 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:

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:

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:

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.

REFERENCES:

1. Traffic Flow Theory: A Monograph , TRB Special Report 165
2. Fundamentals Of Transportation Engineering – C.S.Papacostas, Prentice Hall India Publication
3. Principles Of Highway Engineering And Traffic Analysis – F.L.Mannering & W.P.Kilareski, John Wiley Publishers.
4. Traffic Flow Fundamentals – A.D.May, , Prentice Hall India Publication
5. Fundamentals Of Traffic Engineering – Mcshane & Rogers

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(17D93205) ROAD SAFETY ENGINEERING
(Elective III)

Unit I:

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:

Traffic Engineering Studies; Statistical Methods In Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi-Squared Distribution, Statistical Comparisons- Traffic Management Measures And Their Influence On Accident Prevention.

Unit III:

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:

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:

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.

REFERENCES:

1. Traffic Engineering And Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Fundamentals Of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
3. Transportation Engineering – An Introduction, C.Jotin Khisty, B. Kent Lall
4. Fundamentals Of Traffic Engineering, Richardo G Sigua
5. Handbook Of Road Safety Measures, Second Edition, Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorenson
6. Road Safety By NCHRP

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LAND USE AND REGIONAL TRANSPORTATION PLANNING
(Elective-III)

UNIT I:

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 To Regional Planning, Methods Of Delineation Regions, Hierarchy Of Regions, Findings Of Commission On Urbanisation, Introduction To Micro Economic Theories Of Landuse, Concepts By Van Thunan, Christaller And Losch.

UNIT II:

Landuse 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 To Landuse Transport - Interaction, Case Study Examples.

UNIT III:

Regional Travel Demand Estimation: Factors Affecting Goods And Passenger Flows, Use Of Mathematical Models To Estimate 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:

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:

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.

REFERENCES:

1. Barra, T. D., Integrated Landuse And Transport Modelling: Decision Chains And Hierarchies, Cambridge University Press, 2005.
2. Baxter Et Al, Urban Development Models, Construction Press.
3. Blundon, W. R. And J Black, The Land Use Transport System, 2nd Edition, Australian National University Press, 1984
4. Bruton, M. J., An Introduction To Transportation Planning (The Living Environment), UCL Press, London, UK, 2000.
5. C.J. Khisty And B. Kent Lall, Transportation Engineering, Prentice Hall Of India Pvt. Ltd., 2002.
5. C.S. Papacostas And P.D. Prevedouros, Transportation Engineering And Planning, Prentice Hall Of India Pvt. Ltd., 2001.
7. Chari, S. R., Landuse Transportation Planning, Lecture Notes, REC, Warangal, 1988
8. Dicky J.W., Metropolitan Transportation Planning, Script Book Co., Washington, D.C., 1975.
9. John D. Edwards, Transportation Planning Handbook, Second Edition, Institution Of Transportation Engineers, 1999.
10. Wilson, A.G., Regional And Urban Models In Geography And Planning, Pion Press.

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(17D93207) TRANSPORTATION SYSTEM MANAGEMENT
(Elective-III)

UNIT-I:

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:

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:

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:

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:

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.

REFERENCES:

1. Transportation System Management Notes, S.R.Chari, Rec, Warangal
2. Metropolitan Transportation Planning, John W Dickey, Tata Mcgraw Hill
3. The Bicycle Planning, Mike Hudson, Open Books, Uk
4. Transportation Engineering– An Introduction – C.Jotin Khisty& B. Kent Lall, Prentice Hall.
5. Traffic and Highway Engineering – Nicholas J.Garber and Lester A. Hoel, Cengage Learning, USA, 2009.

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**(17D93208) ENVIRONMENTAL IMPACT ASSESSMENT FOR TRANSPORTATION
PROJECTS
(Elective - IV)**

UNIT-I:

Introduction: Environment And Its Interaction With Human Activities - Environmental Imbalances - Attributes, Impacts, Indicators And Measurements - Concept Of Environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives Of EIA, Advantages And Limitations Of EIA

UNIT-II:

Environmental Indicators - Indicators For Climate - Indicators For Terrestrial Subsystems - Indicators For Aquatic Subsystems - Selection Of Indicators - Socio-Economic Indicators - Basic Information - Indicators For Economy - Social Indicators - Indicators For Health And Nutrition - Cultural Indicators - Selection Of Indicators.

UNIT-III:

Environmental 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:

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:

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

REFERENCES:

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

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

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(17D93209) GIS APPLICATIONS IN TRANSPORTATION ENGINEERING
(Elective – IV)

UNIT-I:

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:

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:

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:

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:

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 Based Highway Alignment, GIS Based Road Network Planning, GIS Based Traffic Congestion Analysis And Accident Investigation.

REFERENCES:

1. GIS for Urban & Regional Planning, Scholten & Stillwen, 1990, Kulwer Academic Publisher.
2. GIS A Management, Perspenfi Stan Aronoff, WDL Publisher.
3. GIS By Stonffer

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(17D93210) OPTIMIZATION TECHNIQUES
(Elective – IV)

Unit-I:

Linear Programming: Introduction And Formulation Of Models; Convexity; Simplex Method; Two Phase Method; Degeneracy, Non - Existent And Unbounded Solutions; Duality In L.P. Dual Simplex method, Sensitivity Analysis; Revised Simplex Method; Transportation And Assignment Problems.

Unit-II:

Non-Linear Programming: Classical Optimisation Methods; Equality And Inequality Constraints; Lagrange Multipliers; & Kuhn-Tucker Conditions; Quadratic Forms; Quadratic Programming And Seal's Methods.

Unit-III:

Search Methods: One Dimensional Optimisation; Fibonacci Search; Multi Dimensional Search Methods; Univariate Search; Gradient Methods; Steepest Descent/Ascent Methods; Conjugate Gradient Method; Fletcher - Reeves Method; Penalty Function Approach.

Unit-IV:

Dynamic Programming: Principle Of Optimality; Recursive Relations; Solution Of L.P.Problem; Simple Examples.

Unit-V:

Integer Linear Programming: Gomory's Cutting Plane Method; Branch And Bound Algorithm; Travelling Salesman Problem; Knapsack Problem; Linear C-1 Problem.

REFERENCES:

1. Introduction to Optimisation - J.C.Pant; Jain Brothers; New Delhi.
2. Optimisation Theory and Applications - S.S.Rao; Wiley Eastern Ltd., New Delhi.
3. Optimisation Methods - K.V.Mital; Wiley Eastern Ltd.. New Delhi.

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(17D93211) TRAFFIC ENGINEERING LAB

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. Applications of MX-Roads Software.

4. 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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(17D20301) RESEARCH METHODOLOGY
(Elective V-OPEN ELECTIVE)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design – Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text Books:

1. Research Methodology:Methods And Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step By Step Guide For Beginners- Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. Research Methodology And Statistical Tools – P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

REFERENCES:

1. Scientists Must Write - Robert Barrass (Available As Pdf On Internet)
2. Crafting Your Research Future –Charles X. Ling And Quiang Yang (Available As Pdf On Internet)

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(17D20302) HUMAN VALUES AND PROFESSIONAL ETHICS
(Elective V-OPEN ELECTIVE)

Unit I:

HUMAN VALUES: Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty – Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

Unit II:

ENGINEERING ETHICS: Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg's theory- Gilligan's theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

Unit III :

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT IV:

ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK: Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing riskSafety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UNIT V:

GLOBAL ISSUES: Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics .

Text Books :

1. "Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and

- V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
- 2.. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
 - 3.“Ethics in Engineering” by Mike W. Martin and Roland Schinzinger – Tata McGrawHill– 2003.
 4. “Professional Ethics and Morals” by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.
 5. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran , Laxmi Publications.

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(17D20303) INTELLECTUAL PROPERTY RIGHTS
(Elective V-OPEN ELECTIVE)

UNIT – I

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.

Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.

International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS & REFERENCES:

1. Intellectual Property Right, Deborah. E. Bouchoux, Cengage Learning.
2. Intellectual Property Right – Nleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,