M.Tech (Transportation Engineering)

Branch: Civil Engineering

**1st semester Course Work**

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<tr>
<th>Course Name</th>
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<tr>
<td>1. Advanced Mathematics</td>
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<tr>
<td>2. Analysis and Design of Pavements</td>
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<td>3. Traffic engineering</td>
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<td>4. Project engineering &amp; management</td>
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<tr>
<td>5. Advanced foundation engineering</td>
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<td>6. Elective-I</td>
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<tr>
<td>a) Bridge engineering</td>
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<td>b) Advanced structural analysis</td>
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<td>c) Ground improvement techniques</td>
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<td>7. CAD &amp; Computational laboratory</td>
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<td>Total No.of Hrs / Week</td>
<td>24</td>
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**2nd semester Course Work**

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<tr>
<td>1. Operation research</td>
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<td>2. GIS in Transportation Engineering</td>
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<td>3. Pavement construction and management</td>
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<td>4. Urban transportation planning</td>
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<td>5. Environmental impact assessment</td>
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<td>6. Elective-II</td>
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<tr>
<td>a) Remote sensing and GPS for transportation engineering</td>
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<td>b) Air port engineering</td>
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<td>c) Rural roads</td>
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<td>7. Traffic and highway engineering laboratory</td>
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<tr>
<td>Total No.of Hrs / Week</td>
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**IIIrd & IVth semester**

1. Seminar
2. Project work
SYLLABI of I Semester Subjects

1. Advanced Mathematics

UNIT-1
Applied partial Differential Equations: One-dimensional Heat equation Cartesian, cylindrical and spherical coordinates (problems having axi-symmetry)

UNIT-2
Two-dimensional Laplace Equation in Cartesian, cylindrical and spherical coordinates (problems having axi-symmetry) – Analytical solution by separation of variables technique

UNIT-3

UNIT-4

UNIT-5
Correlation of grouped bi-variate data – coefficient of determination Multiple Regression – partial Regression coefficients.

UNIT-6
Tests of significance – Analysis of variance for regression – Multiple correlation coefficients – Multiple linear regression with two independent variables.

UNIT-7
Linear Programming Problem Formation, Graphical Method, Simplex method, artificial variable method-Big-M method-Two Phase Method.

UNIT-8
Non Linear Programming Problem Gradient method, Steepest Ascent Descent Methods.

TEXT BOOKS

2. Analysis and Design of Pavements

UNIT-I
Pavement types, stress distribution pavements – theoretical and actual
Sub grade conditions and traffic loading.

UNIT-II
Design principle and methods for flexible and rigid pavements.

UNIT-III
Design of heavy duty pavements.

UNIT-IV
Concrete block pavements.

UNIT-V
Evaluation of pavement condition, pavement instrumentation:

UNIT-VI
Types of pavement distresses, their origins and remedy.

UNIT-VII
Roughness and skid resistance. Environmental effects and influences.

UNIT-VIII
Pavement maintenance, overlays. Pavement management systems.

References:

Shell Pavement Design Manual – asphalt pavements and overlays for road traffic, by Nilanjan Sarkar, Ooms Avenhorn Holding India Pvt.Ltd;
Highway engineering by khanna & justo
3. Traffic engineering

UNIT-I. TRAFFIC CHARACTERISTICS:
Basic traffic characteristics - Speed, volume and concentration. Relationship between Flow, Speed and Concentration

UNIT-II 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;

UNIT-III SPEED STUDIES:
Methods of conducting speed studies; Presentation of speed study data; Head ways and Gaps; Critical Gap; Gap acceptance studies.

UNIT-IV 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 free ways.

UNIT-V PARKING STUDIES AND ANALYSIS:
Types of parking facilities - on street parking and off street Parking facilities; Parking studies and analysis.

UNIT-VI 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.

UNIT-VII TRAFFIC CONTROL AND REGULATION:

UNIT-VIII TRAFFIC AND ENVIRONMENT:
Detrimental effects of Traffic on Environment; Air pollution; Noise Pollution; Measures to curtail environmental degradation due to traffic.

REFERENCES:
4. Project engineering & management


as a Team Leader - Leadership Qualities, PMIS


UNIT-V Project Scheduling and Analysis Methods: CPM, PERT, Linear programming, queuing concept, simulation, bidding models, game theory.


UNIT-VII Resource Management and Inventory: Basic concepts, labour requirements & productivity, nonproductive activities, site productivity, equipment and material management, inventory control


REFERENCES:

2. K.Waker A Teraih and Jose M.Grevann; Fundamentals of Construction Management and Organisations.
5. Advanced Foundation Engineering

UNIT-I
Bearing capacity of shallow foundation, applications of bearing capacity theories, methods – Terzaghi, Mayerhoff, Brinch Hanson, Skempton, Balla.

UNIT-II
Field methods – standard penetration test, factors effecting N value, Plate load test, Coefficient of Sub grade reaction and its determination.

UNIT-III
Settlement analysis – Elastic and consolidation settlement, settlement estimates from penetration test, plate load test, construction period correction.

UNIT-IV
permissible total and differential settlement, causes of settlement, control of settlement, remedial measures, proportion of footing, contact pressure and active zone from pressure bulb concept.

UNIT-V
Factors effecting failures of foundation, case studies, and remedial measures.

UNIT-VI
Pile foundations – selection of pile foundation, load carrying capacity – dynamic formula, static formula, pile load test - pull out test, lateral load test, initial load test, routine load test, cyclic load test.

UNIT-VII
settlement of pile and pile groups, negative skin friction, laterally loaded piles – Broom’s analysis, IS code method. Under reamed piles, method and design.

UNIT-VIII
Caissons and well foundations – design aspects of caissons, open caissons, pneumatic caissons, floating caissons, well foundations, monoliths, design and construction aspects of well foundations.


6. Elective-I

a) Bridge engineering

UNIT-I
Introduction - Classification - Investigation for bridges - Loading standards - IRC and Railway loads - Impact

UNIT-II
Bridge substructure - Determination of maximum flood discharge - Determination of linear water way

UNIT-III
Bridge substructure - Determinations of maximum depth of scour - loads acting on substructure - design of pier and pier cap - design well elements - sinking of wells.

UNIT-IV
Bridge Superstructure - Pigeaud's curves method for design of slab - Analysis of beams - Courbon's Method - Hendry Jaeger Method - Guyon and Massonet Method

UNIT-V
Bridge Superstructure-Box Girder Bridges - Grillage analogy

UNIT-VI
Cable Bridges - Advantages - Arrangement of tay cables - types of towers – Linear analysis of cables, and towers.

UNIT-VII
Bridge Bearings and expansion joints - Functions types and selection of bearings - bearing materials

UNIT-VIII
Design of electrometric bearings for different conditions - expansion joints - types of expansion joints.

REFERENCES:

5. The analysis Grid Frameworks and related structures - Hendry & Jaeger - Chatto & Windus, 1958
b) Advanced structural analysis

UNIT - I
Moment Distribution method: Application to the analysis of portal frames with inclined legs, gable frames

UNIT – II
Strain energy method: Application to the analysis of continuous beams and simple portal frames.

UNIT - III
Influence lines: Influence line diagrams for Reaction, Shearing force and Bending moment in case of determinate beams and Influence line diagrams for member forces in determinate trusses – application of influence line diagrams.

UNIT - IV
Analysis Two hinged and Three hinged arches using influence lines.

UNIT - V
Flexibility Method: Introduction to the structural analysis by flexibility concept using Matrix approach and application to continuous beams and plane trusses.

UNIT - VI
Stiffness method: Introduction to the structural analysis by stiffness concept using Matrix approach and application to continuous beams and plane trusses.

UNIT - VII
Analysis of portal fames by flexibility and stiffness methods. Drawing of bending moment diagram.

UNIT - VIII

TEXT BOOKS:
3. Comprehensive Structural Analysis Vol.1 & 2 by Dr. Vaidyanathan and Dr. P.Perumal – by Laxmi, publications Pvt. Ltd.,New Delhi

REFERENCES:
1. Structural Analysis by D.S.Prakash Rao - Sagar books
c) Ground improvement techniques

UNIT-I Introduction to Ground Modification:

Need and objectives of Ground Improvement, Classification of Ground Modification Techniques - suitability and feasibility, Emerging Trends in ground improvement.

UNIT-II Mechanical Modification:

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

UNIT-III Hydraulic Modification:

Methods of dewatering - open sumps and ditches, Wellpoint system, Electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains.

UNIT-IV Physical and chemical modification:

Stabilisation with admixtures like cement, lime, calcium chloride, fly ash and bitumen.

UNIT-V Grouting:

Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control.

UNIT-VI Reinforced Earth Technology:

Concept of soil reinforcement, Reinforcing materials, Backfill criteria, Art of reinforced earth technology, Design and construction of reinforced earth structures.

UNIT-VII Soil Confinement Systems:

Concept of confinement, Gabbion walls, Crib walls, Sand bags, Evergreen systems and fabric formwork.

UNIT-VIII Miscellaneous Techniques:

Design, Construction and applications of stone columns, lime columns and Cofferdams.

References:

7. CAD& Computational Laboratory

DATA PROCESSING AND GRAPHICAL PRESENTATION USING MS EXCEL & ACCESS: Creation of Data Processing Templates, Usage of standard functions, Statistical Analysis, Macros, Graphical Presentation of Data

MATHEMATICAL AND STATISTICAL PACKAGES (EX: MATLAB & SPSS): Linear Regression, Multiple Linear Regression, Non-linear Regression, Stepwise regression and TWOStage regression. Fitting statistical Distributions, Time Series Analysis, Multivariate Analysis

BASICS OF AUTOCAD: 2D Drawing and Advance Features, Modelling and Imaging in 3D
1. Operations Research

UNIT-I & II
Linear programming Introduction & problem formulation.

UNIT-III
Graphical solutions – SIMPLEX method

UNIT-IV
Duality in Linear programming.

UNIT-V
Transportation problem

UNIT-VI
Assignment and routing problem.

UNIT-VII & VIII
Queuing theory.

References:
Operation research by Kanti Swarup, Gupta and Manmohan.
Operation research and statistical analysis by S.D.Sharma
2. GIS IN TRANSPORTATION ENGINEERING

UNIT-I  Introduction to GIS:

Introduction, GIS overview, use of GIS in decision making, Data processing, Components of GIS, The GIS and the organization.

UNIT-II  Data Input and Output:

Data input - Keyboard entry, Manual digitizing, Scanning, Remotely and sensed data, existing digital data, census related data sets, Data output - Hard copy and soft, copy devices.

UNIT-III  Data Quality:

Components of data quality - Micro level, Macro level components, Sources of error, A note about data accuracy.

UNIT-IV  Data Management:

The data base approach, 3 classic data models, Nature of geographic data, Spatial data models, Databases for GIS.

UNIT-V  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-VI  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-VII  Application of GIS in Transportation Engineering – I:

Intelligent information system for road accessibility study, GIS data base design for physical facility planning, Decision support systems for land use planning

UNIT-VIII  Application of GIS in Transportation Engineering – II:

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 A Management, Perspenfi Stan Aronoff, WDL Publisher.
3. Pavement construction and management

UNIT-I PAVEMENT MANAGEMENT SYSTEM:

UNIT-II PAVEMENT INVENTORIES AND EVALUATION:

UNIT-III PAVEMENT MAINTENANCE AND QUALITY CONTROL:
Causes of Deterioration, Traffic and Environmental Factors, Pavement Performance Modelling Approaches and Methods, 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, SHOULDERS AND DRAIN:

UNIT-V BITUMINOUS PAVEMENT CONSTRUCTION:

UNIT-VI CEMENT CONCRETE PAVEMENT ANALYSIS:
Construction of Cement Concrete Roads, Manual and Mechanical Methods, Joints in Concrete and Reinforced Concrete Pavements, Interface Treatment and overlay construction - Related Equipment.

UNIT-VII PAVEMENT LIFE CYCLE COST ANALYSIS:
Cost Components, Methods of LCA - Brief Description - Items Considered - Case Studies

UNIT-VIII PAVEMENT MAINTENANCE MANAGEMENT:

REFERENCES:
3. Bridge and Pavement Maintenance - Transportation Research Record No. BOO, TRB
4. Urban transportation planning

UNIT-I   TRAVEL DEMAND CONCEPT:

Demand function: Independent variables: Travel attributes; Assumptions in Travel demand estimation; Sequential, Sequential recursive and Simultaneous process.

UNIT-II& III.   DATA COLLECTION AND INVENTORIES:

Study area definition; Zoning principles; Travel data collection - Road side interview, Home interview; IPT surveys; Sampling techniques; Expansion factors; Use of Secondary sources in data collection.

UNIT-IV   TRAVEL DEMAND ESTIMATION:

Four step Travel Demand Forecasting approach; Trip generation Analysis; Zonal models Category analysis; Household models; Trip attraction of work centres.

UNIT-V   TRIP DISTRIBUTION:

Mode Factor methods; Gravity model; opportunity model.

UNIT-VI   MODE SPLIT ANALYSIS:

Mode choice behaviour; Comp~ting modes; Diversion curves; Probabilistic approaches.

UNIT-VII& VIII   TRAFFIC ASSIGNMENT:

Traffic network and coding; Minimum path trees; All or nothing assignment; Capacity restraint assignment; Corridor Identification; Plan preparation and Evaluation; Deficienc analysis.

References:

Introduction to Transportation Planning - M.J.Bruton; Hutchinson cf London Ltd.
Introduction to Urban System Planning - B.G.Hutchinson; Mc Grah Hill.
Urban Transportation Planning Guide - Roads & Transportation AS-C(i<:tion of Canada;
University of Toronto Press.
Traffic Engineering and Transport Planning - Kadiyali L.R. Khanna Publish;
Lecture notes on UTP - Prof. S.Raghavachari, R.E.C. Warangal
5. Environmental impact assessment

UNIT-I
Introduction: Environment and its interaction with human activities – Environmental imbalances – Attributes, Impacts, Indicators and Measurements - Concept of Environmental Impact Assessment (EIA),

UNIT-II
Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA

UNIT-III
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-IV
Environmental issues in water resource development - Land use - Soil erosion and their short and long term effects - Disturbance and long term impacts - Changes in quantity and quality of flow – Sedimentation –

UNIT-V

UNIT-VI

UNIT-VII
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-VIII

REFERENCES:
6. Elective-II

a) Remote sensing and GPS for transportation engineering

UNIT-I REMOTE SENSING:


UNIT-II REMOTE SENSING PLATFORMS & SENSORS:

Introduction, Characteristics of imaging remote sensing instruments, satellite remote sensing system - a brief over view, other remote sensing satellites.

UNIT-III PRE-PROCESSING OF IT EMOTELY SENSED DATA:

Introduction, cosmetic operation, geometric connection and registration, atmospheric correction.

UNIT-IV ENHANCEMENT TECHNIQUE:

Introduction, human visual system, contrast enhancement, Pseudo colour enhancement

UNIT-V IMAGE TRANSFORMS:

Introduction, arithmetic operations, empirically based image transforms, Principal component analysis, Multiple discriminant analysis etc.

UNIT-VI FILTERING TECHNIQUE AND CLASSIFICATION:

Low-pass (smoothing filters), High pass (sharpening) filters, edge detection, frequency domain filters, geometrical basis, classification. Unsupervised and supervised classification, classification accuracy.

UNIT-VII G.P.S.: Introduction, elements of satellite surveying, the global positioning system, GPS satellites, adjustment computations, GPS observables.

UNIT-VIII application of GPS technology in Highway alignment, Network planning.

REFERENCES:-

1. GPS Satellite Surveys, Alfred Leick, Willey & Sons
b) Air port engineering

UNIT-I
Aircraft characteristics. Obstruction criteria.

UNIT-II
Air traffic control.

UNIT-III
Runways: Orientation, length, geometric standards, capacity, configuration.

UNIT-IV
Taxiway, geometric standards, fillets, high speed exit taxiway.

UNIT-V
Apron-gate area and circulation.

UNIT-VI
Terminal building – functional areas and facilities. The planning and site selection.

UNIT-VII

UNIT-VIII
Heliports.

References:
1. Airport Planning and Design by Khanna and Arora.
c) Rural roads

UNIT-I

Planning and Alignment: Planning of rural roads, Concept of Network Planning, rural roads plan, road alignment and surveys, governing factors for route selection

UNIT-II

Geometric Design Standards: Classification of rural roads, basic principles of geometric design, standards for design of various geometric components

Road Materials: Soil, subgrade, stabilised soils, road aggregates, binding material

UNIT-III

Pavement Design: Design parameters, pavement components, design of flexible, rigid, and semi-rigid pavements, drainage and shoulders

UNIT-IV

Culverts and Small Bridges: Geometric standards for culverts, Design loading, design of culverts, types of culverts, causeways and submersible bridge

UNIT-V

Construction and Specifications: Selection of materials and Methodology, Embankment and subgrade, sub-base, base course, shoulder, bituminous constructions, semi-rigid pavement construction,

UNIT-VI

Concrete pavements, equipment required for different operations.

UNIT-VII


UNIT-VIII

Cement stabilised fly ash, iron and steel slag, Lime-rice husk ash concrete, recycled concrete aggregate. Introduction to quality control in construction of rural roads and their maintenance

References:

7. Traffic and highway engineering laboratory

1. Traffic surveys like traffic volume count,
2. Parking study, intersection turning movements,
3. Speed & delay study.
4. Road side and house hold interviews.
5. Tests on aggregates,
6. Tests on bitumen,
7. Tests on sub grade soil,
8. Mix design of bitumen and aggregates for different construction techniques.