

## M.Tech (Transportation Engineering)

### Branch: Civil Engineering

<b>I<sup>st</sup> semester Course Work</b>	<b>T</b>	<b>P</b>
1. Advanced Mathematics	4	-
2. Analysis and Design of Pavements	4	-
3. Traffic engineering	4	-
4. Project engineering & management	4	-
5. Advanced foundation engineering	4	-
6. Elective-I	4	-
a) Bridge engineering		
b) Advanced structural analysis		
c) Ground improvement techniques		
7. CAD & Computational laboratory	-	4
Total No.of Hrs / Week	<u>24</u>	<u>4</u>

<b>II<sup>nd</sup> semester Course Work</b>		
1. Operation research	4	-
2. <b>GIS in Transportation Engineering</b>	4	-
3. Pavement construction and management	4	-
4. Urban transportation planning	4	-
5. Environmental impact assessment	4	-
6. Elective-II	4	-
a) Remote sensing and GPS for transportation engineering		
b) Air port engineering		
c) Rural roads		
7. Traffic and highway engineering laboratory	-	4
Total No.of Hrs / Week	<u>24</u>	<u>4</u>

### **III<sup>rd</sup> & IV<sup>th</sup> 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**

Numerical solutions to Heat and Laplace Equations in Cartesian coordinates using finite – differences. Implicit methods, Crank NicholSEN Method, Jacobi Method, Gauss Seidal method.

#### **UNIT-4**

Applied Statistics: Regression and correlation analysis – Method of Least squares – Curve fitting – Curvilinear Regression – Non-linear curves – correlation coefficient –

#### **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**

1. Solutions of Partial Differential Equations” – Duffy, D.G. CBS Publishers, 1988
2. Introductory Methods of Numerical Analysis – Sastry, S.S. Prentice-Hall, 2<sup>nd</sup> Edition, 1992
3. Basic Statistics – Agarval, B.L., Wiley 1991, 2<sup>nd</sup> edition.
4. Operations Research – Hamdy A, Taha.
5. Optimization Techniques.- S.S.Rao:.

## **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:**

Pavement Analysis and Design, second edition, by Yang H. Huang, Prentice Hall publishers.  
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:**

Traffic Signals - Design of Isolated Traffic Signal by Webster method, Warrants for signalisation, Signal Co-ordination methods, Simultaneous, Alternate, Simple progressive and Flexible progression Systems.

#### **UNIT-VIII TRAFFIC AND ENVIRONMENT:**

Detrimental effects of Traffic on Environment; Air pollution; Noise Pollution; Measures to curtail environmental degradation due to traffic.

#### **REFERENCES:**

1. Traffic Engineering and Transportation Planning - L.R. Kadiyali, Khanna Publishers.
2. Traffic Engineering - Theory & Practice - Louis J. Pignataro, Prentice Hall Publication.
3. Principles of Highways Engineering and Traffic Analysis - Fred Mannering & Walter P. Kilareski, John Wiley & Sons Publication.
4. Transportation Engineering - An introduction - C. Jotin Khistry, Prentice Hall Publication.
5. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.

## **4. Project engineering & management**

**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: Tendering and Contracting, Laws of Contracts, subcontracts, Potential, Problems, Post Contract Problems, Documents, Conditions, Arbitration, Special Features of International, Contracts.

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

**UNIT-VI** Human Resource Management: Man Power Planning - Training - Motivation - Industrial Relations - Welfare Measures - MIS - Components and Structure - Personal Management.

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

**UNIT-VIII** 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.
7. A Guide to the Project Management Body of Knowledge (PMBOK), Draft Copy, 1994. A Publication of the Project management Institute, USA.
8. Sengupta Band Guha H, Construction Management and Planning, Tata McGraw-Hill Publishing Company Limited, New Delhi.

## **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.

**References:** Foundation analysis and Design by Bowles, Mc.Graw Hill Inc., second edition.

Geotechnical Engineering by C. Venkatramayya, New age international publishers. Soil Mechanics and Foundation Engineering, Vol. II, V.N.S. Murthy.

## **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 stay 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:**

1. Analysis and design of substructures - Swami Saran - Oxford & IBH Publishing Co., 1996
2. Bearings in structural engineering - J.E. Long - Newnes Butterworth & Co., 1974
3. Bridge bearings and Expansion Joints - D.J. Lee - 2e - E&FN Span, 1994
4. Concrete Bridge Design - Rowe - John Wiley & Sons inc., 1962.
5. The analysis Grid Frameworks and related structures - Hendry & Jaeger - Chatto & Windus,- 1958
6. Bridge analysis by Microcomputer - Jaeger & Bakht - 1st ed Graw Hill, 1989. '
7. Grillage analogy in bridge deck analysis - C.S Surana & R. Agarwal - Narosa Pub- 1998
8. Method of analysis and design of concrete box beams with side cantilever - Maisel and Roll-Cement and Concrete Associations – 1974
10. Cable stayed bridges - M.S. Troitsky - 2e, Van Nostrand Reinhold Company, 1988

## **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 frames by flexibility and stiffness methods. Drawing of bending moment diagram.

### **UNIT - VIII**

Plastic Analysis: Introduction – Idealized stress – Strain diagram – shape factors for various sections – Moment curvature relationship – ultimate moment – Plastic hinge – lower and upper bound theorems – ultimate strength of fixed and continuous beams.

### **TEXT BOOKS:**

1. Matrix methods of Structural Analysis by Pandit and Gupta – Tata Mc.Graw Hill
2. Analysis of structures Vol. I & II by Vazrani and Ratwani. Khanna publications.
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
2. Structural Analysis Vol. I & II by Bhavi Katti Vikas Publications.
3. Matrix structural analysis by T.N.Gayl; Tata Mc.Graw Hill company

## **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, Gabion 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:**

1. Manfred R. Hansmann - Engineering principles of ground modification - Me. Graw-Hill pub. Co., NewYork.
2. Robert M. Koerner - Construction and Geotechnical methods in Foundation Engineering - MC.Graw-Hill Pub. Co., New'York. .
3. Winterkorn and Fang - Foundation Engineering Hand Book - Van Nostrand Reinhold Co., New York.
4. Aris C. Stamatopoulos & Panaghiotis C. Kotzios - Soil Improvement by Preloading – John Wiley & Sons Inc. Canada.
5. P. Purushothama Rao - Ground Improvement Techniques - Laxmi Publications (P) Limited.

## **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 over view, use of GIS in decision making, Data processing, Components of GIS, The GIS and the organization.

### **UNIT-II. 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-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:**

Components of PMS and their Activities, Major Steps in Implementing PMS, Inputs, Design, Construction and Maintenance, Rehabilitation and Feedback Systems, Example~ of HDM and RTIM Packages, Highway Financing, Fund Generation, Evaluating Alternate Strategies and Decision Criteria.

#### **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, 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:**

Roadway and Drain excavation, Excavation and Blasting, Embankment construction, Construction of Gravel, Lime, Cement stabilised sub-bases, WBM Bases, Wet Mix Construction, Crushed Cement Bases, Shoulder Construction Drainage: Surface/Subsurface, Turfing, Sand Drains, Sand Wicks. Rope Drains, Geo-textile Drainage, Preloading Techniques.

#### **UNIT-V BITUMINOUS 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.

#### **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:**

Components of Maintenance Management and Related Activities - Network and Project Level Analysis - Budgeting - Prioritisation Techniques and Formulation of Maintenance Strategies.

#### **REFERENCES:**

1. Haas and Hudson, W.R. Pavement Management Systems - McGraw Hill
2. Sargious, M.A. - Pavements and Surfacing for Highways and Airports - Applied Science Publishers Ltd.
3. Bridge and Pavement Maintenance - Transportation Research Record No. BOO, TRB
4. Shahin MY, 1994 - Pavement Management for Airports, Roads and parking Lots.
5. Bent Thagesan, 1996 - Highway and Traffic Engineering for Developing Countries.

## **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 of London Ltd.  
Introduction to Urban System Planning - B.G.Hutchinson; Mc Gra 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;;,s  
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**

Environmental impact assessment of water resource development structures – Case studies, Water Quality Impact Assessment - Attributes, Water Quality Impact Assessment of Water

### **UNIT-VI**

Resources Projects, Data Requirements of Water Quality Impact Assessment for Dams, Impacts of Damson Environment, Case Studies.

### **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**

Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies .Ad hoc, 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.

## **6. Elective-II**

### **a) Remote sensing and GPS for transportation engineering**

#### **UNIT-I REMOTE SENSING:**

Basic Principles - Introduction, Electromagnetic and its properties, interactions with Earth's surface materials, recent developments in Remote sensing, Social and legal implications of Remote Sensing, status of Remote Sensing.

#### **UNIT-II. REMOTE SENSING PLATFORMS & SENSORS:**

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

#### **UNIT-III PRE-PROCESSING OF REMOTELY SENSED DATA:**

Introduction, geometric operation, geometric correction 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
2. Principles of Remote Sensing, Paul Juman, ELBS, 1985
3. Computer Processing of Remotely sensed Images An introduction - Paul M. Mather, John Willey & Sons 1989.

## **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**

Pavement design and evaluation. Visual aids. Drainage.

### **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**

Use of Waste Materials: Fly ash for road construction, Lime fly ash stabilised soil, lime fly ash bound macadam, lime fly ash concrete, roller compacted fly ash concrete.

### **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:**

1. IRC SP 20: Rural Roads Manual, Indian Roads Congress, New Delhi, 2002.

## **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.