

**VEER SURENDRA SAI  
UNIVERSITY OF TECHNOLOGY,  
BURLA**

**CIVIL ENGINEERING DEPARTMENT**

**CURRICULUM FOR M. TECH  
IN  
TRANSPORTATION ENGINEERING**

**First (Autumn) Semester:-**

Sub Code	Subjects	L	T	P	Credit
	Geometric Design of Transportation Facilities	3	1	0	4
	Pavement Materials	3	1	0	4
	Traffic Engineering and Management	3	1	0	4
	Elective-I	3	1	0	4
	Elective-II	3	1	0	4
	Highway Materials Lab	0	0	4	4
	Seminar-I	0	0	3	2
	Comprehensive viva voce I				2
	<b>Total</b>	<b>17</b>	<b>3</b>	<b>7</b>	<b>28</b>

**Second (spring) semester :-**

Sub Code	Subjects	L	T	P	Credit
	Analysis & Design of Pavements	3	1	0	4
	Urban Transportation systems planning	3	1	0	4
	Traffic Flow Theory	3	1	0	4
	Elective - III	3	1	0	4
	Elective - IV	3	1	0	4
	Transportation Engg Design	0	0	4	4
	Seminar - II	0	0	3	2
	Comprehensive Viva Voce - II				2
	<b>Total</b>	<b>17</b>	<b>3</b>	<b>7</b>	<b>28</b>

**Third semester (project)**

Sub Code	Subjects	L	T	P	Credit
	Dissertation interim evaluation				10
	Comprehensive Viva Voce - III				3
	Seminar on Dissertation				2
	<b>Total</b>				<b>15</b>

**Fourth Semester (Project)**

Sub Code	Subjects	L	T	P	Credit
	Dissertation Open				5
	Dissertation evaluation				20
	<b>Total</b>				<b>25</b>
	<b>Grand total</b>				<b>96</b>

	<b><u>Electives –I &amp; II (First Semester):-</u></b>	<b><u>Sub Code</u></b>
<b>1</b>	<b>Analysis of Transportation Systems</b>	
<b>2</b>	<b>Transport and Environment</b>	
<b>3</b>	<b>GIS Applications in Transportation Engineering</b>	
<b>4</b>	<b>Bridge Engineering</b>	
<b>5</b>	<b>Advanced Numerical Methods</b>	
<b>6</b>	<b>Optimisation Methods</b>	
<b>7</b>	<b>Applied Soil Mechanics</b>	
<b>8</b>	<b>Rock Mechanics and Tunnelling</b>	
<b>9</b>	<b>Computational and Statistical Methods</b>	

	<b><u>Electives – III &amp; IV (Second Semester):-</u></b>	<b><u>Sub Code</u></b>
<b>1</b>	<b>Mass and Multimodal Transportation Systems</b>	
<b>2</b>	<b>Highway Construction practice</b>	
<b>3</b>	<b>Pavement Evaluation, Rehabilitation and Maintenance</b>	
<b>4</b>	<b>Environmental Impact Assessment and Auditing</b>	
<b>5</b>	<b>Transportation Economics</b>	
<b>6</b>	<b>Ground Improvement Techniques</b>	
<b>7</b>	<b>Airport Planning and Design</b>	
<b>8</b>	<b>Structural Optimization</b>	

# **DETAILED SYLLABUS**

## **Geometric Design of Transportation Facilities (3-1-0)**

Geometric design provisions for various transportation facilities as per IRC and other guidelines, Discussion of controls governing geometric design, route layout and selection. Elements of design – sight distances, horizontal alignment, transition curves, super – elevation and side friction. Vertical alignment – grades, crest and sag curves. Highway cross – sectional elements and their design for rural highways, Urban streets and hill roads. At grade intersections – sight distance consideration and principles of design, Channelization, mini round –abouts, layout of round –abouts, Inter – Changes – major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes, Bicycle and pedestrian facility design, Parking layout and design, Terminal layout and design.

### **Ref Books:-**

- i Principles & Practice of Highway Engg – Dr. L.R. Kadiyali & Dr.N.B.Lal – Khanna Publishers
- ii. IRC codes
- iii. Geometric Design of Roads - Robin T. Underwood, Macmillan Company of Australia

## **Pavement Materials (3-1-0)**

Subgrade functions, Importance of subgrade soil properties on pavement performance. Identification and significance of soil characteristics, Soil classification, Effect of water on swelling and shrinkage, Cohesion and Plasticity. Road making aggregates – Classification, Properties of aggregates, design of aggregate gradation, texture, polishing and skid resistance. Bituminous road binders – Straight- run bitumen, emulsions, Cutback and modified binders. Rheology of bituminous binders, modified binders – adhesion and stripping, penetration index, viscosity, temperature susceptibility of viscosity. Additives and their suitability, Fillers. Design of Bituminous mixes – Marshall method and super paves procedure. Visco-elastic and fatigue properties of bituminous mixtures, resilient modulus of pavement materials. Requirements of paving concrete, design of mixes – IRC.

### **Ref Books:-**

- i. Principles & practice of Highway Engg\_-Dr. L. R. Kadiyali & Dr. N. B. Lal - Khanna Publishers
- ii. Principle of Transportation Engg.- Partha Chakraborty & Animesh Das – Prentice Hall

## **Traffic Flow Theory (3-1-0)**

Component of Traffic Flow System, Traffic variables and parameters, Driver behaviour modeling, Simulation, Controlled – Access Concept, Freeway Concept, System performances, Measure of effectiveness. Flow through transportation networks – various types of graphs, determination of link and chain flows, finding maximum flow values of capacitated networks. Capacity of a roadway, Bottlenecks. Approaches to traffic flow theory, Traffic flow relationships – flow at different densities, Shock wave phenomenon, time – Space diagram. Mathematical modeling, Probabilistic and Stochastic models of traffic flow process, Discrete and Continuous modeling headways, Gaps and process of gap acceptance, Macroscopic models, Car – following model, Queuing models, fundamentals & developments of queuing process, Applications. Indices of Level of Service (LOS) as offered to road users.

Ref book : i. A course in Traffic Planning and Design – S. C.Saxena – Dhanpat Rai & Sons

ii. Traffic Engg.& Transportation Planning – L.R. Kadiyali - Khanna Publishers

iii. Traffic Flow Theory and Control - Donald R. Drew- TMH

iv. Traffic Engineering - Roger P. Roess, Elena S. Prassas, William R. McShane- Prentice Hall

v. Traffic Flow Fundamentals- Adolf D. May-Prentice Hall

## **Analysis of Transportation Systems**

**(3-1-0)**

Introduction to Transportation systems, Transportation innovations, Social and Economic impacts of Transportation, Decision makers and their options, Demand modeling and prediction, Supply and equilibrium flows, Modelling and transportation technology, Analysis of network flows, Transportation network, Network theory, Concepts in transportation models and location models, Analysis of utility maximizing systems such as entropy Concepts, Major transportation technologies, Cost functions and estimation, Urban transport economic policy, Models for selecting network investments and operation planning, Case Studies.

Ref book:

- i. A course in Traffic Planning and Design – S. C.Saxena – Dhanpat Rai & Sons
- ii. Traffic Engg. & Transportation Planning – L.R. Kadiyali - Khanna Publishers
- iii. Urban Transportation Networks - Yosef Sheffi - PRENTICE-HALL.

## **Transport and Environment**

**(3-1-0)**

Modes of Transportation, Mixed traffic flow, Transport related pollution, Road transport related air pollution, Sources of air pollution, Effects of Weather Conditions, Vehicular emission parameters, Pollution standards, Measurement and analysis of vehicular emission, Mitigative Measures. Urban and non-urban traffic noise sources, Noise level factors, Effects of traffic noise, Propagation and measurement of traffic noise, Prediction and control measures, Noise studies, Noise standards. EIA requirements of highway projects, EIA procedures, guidelines, EIA practices in India.

Ref book:

- i. Environmental Impact Assessment-Larry.W.Canter- MC Graw Hill

## **GIS Applications in Transportation Engineering**

**(3-1-0)**

Remote sensing: Physics of remote sensing, Ideal remote sensing system, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC, Interpretation of remote sensing images.

Digital image processing : Satellite image – characteristics and formats, Image histogram, Introduction to image rectification, Image enhancement, Land use and land cover classification system.

Geographic information system (GIS) : Basic concept of geographic data, GIS and its components, Data acquisition, Raster and vector formats, Topography and data models, Spatial modeling, Data output, GIS applications. Global positioning system (GPS) : Introduction, Satellite navigation system, GPS- space segment, Control segment, User segment, GPS satellite signals, Receivers; Static, Kinematic and Differential GPS. Applications in Transportation Engineering

Ref Book:

- i. Basics of Remote Sensing & GIS- S Kumar- Laxmi Publication
- ii. GIS – Kang – T.Sung – TMH Publication

## **Bridge Engineering**

**(3-1-0)**

Reinforced concrete slab bridge decks, Tee beam and slab bridge deck, Plate girder bridges, Composite bridges, Pre-stressed concrete bridges, Steel trussed bridges; Orthotropic plate theory, Determination of rigidity parameters. Load distribution in different girders Courbon s method, Morice-Little method. Box girder bridges - finite element and finite strip analyses, finite difference analysis of deck slab, grillage analysis; Cable stayed and suspension bridges; Bridge

construction; Bridge maintenance

Reference Books:

- (i) Principles and Practice of Bridge Engineering- S.P. Bindra - Dhanpat Rai & Sons, New Delhi
- (ii) Essential of Bridge Engineering- D.J. Victor, - Oxford & IBH Pub. Co. Ltd. Mumbai

### **Advanced Numerical Methods**

**(3-1-0)**

Linear Algebra: Matrices, Matrices decomposition: LU decomposition, Cholesky decomposition, Spectral decomposition, Matrix Eigen-value problem, Gerchgorin's theorem, Eigen value by iteration, generalized inverse of a matrix, solution of linear system by decomposition method, Jacobi method. Nonlinear system of equations: Newton's method, Powel hybrid method.

Differential equations: Generalised characteristic value problems, phase plane and critical points, stability and phase plane methods in nonlinear equations. Boundary value problems, mixed boundary conditions, boundary conditions at infinity, nonlinear boundary value problems, linear eigen value problems. Partial differential equations: Parabolic, elliptic and hyperbolic partial differential equations subjected to Dirichlet, Neumann (or flux) and mixed (or Robin or radiation) boundary conditions, Navier Stock's equation. Approximate analytic methods: Variational methods, Weighted residual methods – Galerkin's method, collocation method, Functional, Quadraic convergence of solution. Finite element and Boundary element method. Software like MATHEMATICA and MATLAB in addition to programming languages C and C++. Application towards plane stress and plane strain two dimensional problems.

Ref book: -

- i. Numerical Methods & Computational Technique- S.S. Shastri
- ii. Numerical Methods for Engineers & Scientists- J.D. Hoffman-2<sup>nd</sup> Edition-Marcel Dekke, New York
- iii. Numerical Methods for Engineers-S. Chapra & RCenale-Mc Graw Hill

### **Optimization Methods**

**(3-1-0)**

Formulation of optimization problems, classical optimization methods. Unconstrained and constrained minimization techniques. Penalty functions. Method of feasible directions and gradient projection. Linear programming. Applications to engineering problems.

Ref books:

- i. Optimisation Technique – Kalyanmay Dey - Mc Graw Hill Publication
- ii. Optimisation Methods - S.S. Rao – Tata Mc Graw Hill

### **Applied Soil Mechanics**

**(3-1-0)**

Role of soil testing in Geotechnical engineering. Basic concept of stress path and its representation in various spaces, and its simulation to practical problems. Analysis of soil behaviour, Kondner's hyperbolic stress-strain response and its application. Evaluation of various elastic constants for practical use. Stability of embankments on clayey soils. Design of berms. Stage construction. Design of sand-drain system. Stress distribution under earth embankments and evaluation of settlement profile. Landslides and their classification. Stability analysis of natural slopes. Different stability analysis models. Limit state analysis of slopes. Earthquake loading considerations. Deep excavations, dewatering operations, drainage, methods of stabilizing slopes. Design of filter, rock toe. Seepage control through the dam body and foundation; Curtain walls, Relief wells and sudden drawdown condition. Instrumentation field problems to monitor movement of slopes, foundations, etc.

- Reference Book- (1) Basic and Applied Soil Mechanics- Gopal Ranjan and A. S. R Rao, New Age International  
(2) Advanced Soil Mechanics- Braja M. Das, Taylor & Francis

## Rock Mechanics and Tunneling

(3-1-0)

Introduction - objective, scope and problems of Rock Mechanics. Classification by origin, Lithological, Engineering. Rock exploration - rock coring, geophysical methods. Laboratory testing of rocks - all types of compressive strength, tensile strength and flexural strength tests. Strength and failure of rocks and Griffith's theory, Coulomb's theory, rheological methods. In-situ tests on rock mass. Deformation characteristics of rocks, instrumentation and measurement of deformation of rocks. Permeability characteristics - interstitial water on rocks, unsteady flow of water through jointed rock mass. Mechanical, thermal and electrical properties of rock mass. Correlation between laboratory and field properties. Analysis of stresses. Thick wall cylinder, formulae, Kreish equation, Green span method. Openings in rock mass and stresses around openings. Pressure tunnels, development of plastic zone. Rock support needed to avoid plastic deformation. Lined and unlined tunnels. Underground excavation and subsidence. Rock mechanics applications. Bearing capacity of homogeneous as well as discontinuous rocks. Support pressure and slip of the joint. Delineation of types of rock failure. Unsupported span of underground openings, pillars. Rock slopes. Rock bolting. Plastic mechanics. Tunnels, shapes, usages, Methods of Construction, Problems associated with tunnels, tunneling in various subsoil conditions and rocks.

### Reference Book-

- (1) Introduction to Rock Mechanics- P.E. Godman, John Wiley, New York.
- (2) Rock Mechanics and Engineering- G. Jager, Cambridge University Press.
- (3) Tunnel Engineering Handbook- J.O. Bickel, T.R. Kuesel, and E.H. King, Chapman & Hall/ITP Publishing Company,
- (4) Rock Mechanics for Engineers: B.P. Verma, Khanna Publishers
- (5) Engineering in Rocks for Slopes, Foundation and Tunnels, Editor T.Ramamurthy, Prentice Hall India Pvt. Ltd.
- (6) Harbour Dock and Tunnel Engineering- R. Srinivasan, Charotar Publishing House.
- (7) Tunnel Engineering- S.C. Saxena, - Dhanpat Rai & Sons, New Delhi

## Analysis and Design of Pavements

(3-1-0)

Philosophy of design of flexible and rigid pavements, Subsystem of pavement design, Basis of pavement design, Analysis of pavements using different analytical methods, Selection of pavement design input parameters – traffic loading and volume, Material characterization, Drainage failure criteria, Reliability pavement support condition, Properties of components and design tests, Design of flexible and rigid pavements using different Methods for highway and airport pavements, Soil stabilization methods, Quality Control and Tolerance, Comparison of different pavement design approaches, Design of drainage system.

Ref book : i. Pavement Design – E.J.Yodder & Wetzick

ii. Principles of Transportation Engg. – P.Chakraborty & A.Das – Prentice Hall

iii. IRC Codes

iv. Pavement Analysis and Design -Yang H. Huang, Pearson Education

v. Pavement Design and Materials- A. T. Papagiannakis, E. A. Masad  
John Wiley & Sons

## Urban Transportation Systems Planning

(3-1-0)

Hierarchical levels of planning, Passenger and Good transportation, General concept and planning process, Urban Travel characteristics, Private and Public Travel Behaviour Analysis, Travel Demand Estimation and Forecasting, Trip Generation Method and their comparison, Trip Distribution, Modal Split Analysis and Trip Assignment, Behavioural Approach.

Trip Generation modeling – variables influencing trip generation, Regression Analysis and Category Analysis, Trip distribution Modeling – factors governing trip distribution, Growth factor Method, Gravity Model, Intervening opportunity and Competing opportunity Models, Modal Split



Modeling – factors influencing Mode choice, Two stage Modal Split Models Transport behaviour of Individuals and Households, Network and Route Assignment, Capacity Restrain and Simultaneous Distribution, Direct Demand Models, Land – Use Transport Planning, Transport Related Land – use Models, Corridor Type Travel Planning, Statewide and Regional Transportation Planning, Introduction to Urban Freight Transportation.

Ref book:

- i. A course in Traffic Planning and Design – S. C.Saxena – Dhanpat Rai & Sons
- ii. Traffic Engg.& Transportation Planning – L.R. Kadiyali - Khanna Publishers
- iii. Principles Of Urban Transport Systems Planning- B. G. HUTCHINSON- Scripta Book Company

### **Highway Construction Practice**

**(3-1-0)**

Embankment Construction: Formation cutting in Soil and hard rock, Preparation of Subgrade, Ground improvement, Retaining and Breast walls on hill roads, Granular and Stabilized, Sub – bases / bases, Water Bound Macadam (WBM), Wet Mix Macadam (WMM), Cement treated bases, Dry Lean Concrete (DLC).

Bituminous Constructions: Types of Bituminous Constructions, Interface Treatments, Bituminous Surfacing and wearing Courses for roads and bridge deck slabs, Selection of wearing Course under different Climatic and Traffic conditions, IRC specifications, Construction techniques and Quality Control. Concrete road construction: Test on Concrete mixes, Construction equipments, Method of construction of joints in concrete pavements, Quality Control in Construction of Concrete pavements, Overlay Construction. Hill Roads Construction: Stability of Slopes, Landslides – Causes and Control measures, Construction of Bituminous and Cement Concrete roads at high altitudes, Hill road drainage, Construction and maintenance problems and remedial measures.

Ref Books:-

- i. Principles & practice of Highway Engg\_–Dr. L. R. Kadiyali & Dr. N. B. Lal - Khanna Publishers
- ii. IRC Codes

### **Mass and Multimodal Transportation Systems**

**(3-1-0)**

Transportation scenario, Public Transportation, Demand characteristics, Spatial, Temporal and Behavioural Characteristics of Transportation Demand, Urban Mass Transportation Planning, Demand Surveys, Estimation and Demand Projection, Four stages of Planning, Performance Evaluation of Mass Transport System, Structure of Decision Making, Evaluation and Selection Methods, Selection Procedures, Economic Evaluation Methods, Terminals and their Functions, Design, Typical Characteristics Scheduling, Service Analysis, Vehicle Despatch Policy, Vehicle Requirements, Spacing of Bus Stops, Route Spacing and Performance, Operational and Management Issues, Reserved Bus Lanes, Signal Preemption, Dial – a – Bus, Vehicle Monitoring and Control System, Modal Coordination, Underground Transportation, Rail Transit, Case Studies. MRTS, LRT, Street Car, Sky Train and other Multiple modes, Behaviour Analysis, Multinomial and nested logit modals, Revealed and Stated Preference, Parking facilities, Operation Strategy.

Ref book ; i. Principles of Urban Transport Planning – B.G. Hutchinson

ii. Traffic Engg.& Transportation Planning – L.R. Kadiyali - Khanna Publishers

iii. Urban Transit Systems and Technology- Vukan R. Vuchic, Willey Publication

iv. Urban Transit: Operations, Planning and Economics- Vukan R. Vuchic, Willey Publication

## **Traffic Engineering and Management**

**(3-1-0)**

Traffic Characteristics – road user and Vehicle Characteristics, Traffic Studies – Volume, Speed, O – D and Parking studies.

Capacity and Level of Service (LOS) analysis, Statistical analysis of traffic flow variables, Traffic Control – principles, methodologies and devices, advance technologies. Fundamentals of Traffic Management, Principles and Methodology, Traffic Systems Management, Technique of management, Exclusive Bus Lanes Traffic management Techniques, Speed control and Zoning, Parking Control, Traffic Segregation and Channelization, Principles and Design of Traffic Signs, Their Placement and Visibility, Transportation System Management, Route and Network Management, Area Traffic Management, City wide Traffic Control and Management, Centralized Data Processing and Monitoring. Element of traffic flow theory, Characteristics of Uninterrupted traffic, Characteristics of interrupted traffic.

- Ref book :
- i. A course in Traffic Planning and Design – S. C.Saxena – Dhanpat Rai & Sons
  - ii. Traffic Engg.& Transportation Planning – L.R. Kadiyali - Khanna Publishers
  - iii. Traffic Flow Theory and Control - Donald R. Drew- TMH
  - iv. Traffic Engineering - Roger P. Roess, Elena S. Prassas, William R. McShane- Prentice Hall

## **Pavement Evaluation, Rehabilitation and Maintenance**

**(3-1-0)**

Types of pavement distress, techniques for functional and structural evaluation of pavements, pavement rehabilitation techniques, Overlay design procedures, recycling of flexible and rigid pavements, maintenance of paved and unpaved roads.

Ref Books:-

- i. Principles & practice of Highway Engg\_-Dr. L. R. Kadiyali & Dr. N. B. Lal - Khanna Publishers
- ii. Principle of Transportation Engg.- Partha Chakraborty & Animesh Das – Prentice Hall
- iii. Flexible Pavement Rehabilitation and Maintenance- Prithvi S. Kandhal, Mary Stroup- Gardiner ASTM International

## **Transportation Economics**

**(3-1-0)**

Economic significance of transport, Demand for transport – influencing factors, temporal and spatial variations, elasticity of demand, Supply of transport Costs – Long – term and short – term Costs, fixed and variable costs, and marginal costs, Pricing of services, Road User Costs, Evaluation of transport projects – Cost – benefit ratio, first year rate of return, net present value and internal – rate of return methods, Indirect Costs and benefits of transport projects, Project ownership and financing, Highway finance and Taxation.

Ref Books:-

- i. Principles & practice of Highway Engg\_-Dr. L. R. Kadiyali & Dr. N. B. Lal - Khanna Publishers
- ii. Urban Transit: Operations, Planning and Economics- Vukan R. Vuchic, Wiley Publication
- iii. Principles of Transport Economics- Quinet, E. Vickerman, R.

## **Environmental Impact Assessment and Auditing**

**(3-1-0)**

Environmental impact assessment (EIA): Environmental statement & target areas fixation, scoping, objectives, water & waste water quality assessment models related to EIA, Air pollutants transport models, noise propagation models, methods for carrying out EIA starting from feasibility studies; case studies of EIA with special emphasis on developmental projects like highways, dams, water supply & sewerage, power plants. Preparation of environmental management plan (EMP) Procedure for obtaining environmental clearance, sitting guidelines for industries. Public participation in carrying out EIA and EMP. Environmental Auditing including resources auditing, water auditing, energy auditing, health auditing: advantages, procedure, case studies.

Ref book:

Env. Impact Assessment – Larry. W. Canter – Mc Graw Hill Publication

### **Ground Improvement Techniques**

**(3-1-0)**

Need of ground improvement; Shallow compaction, Deep compaction; Preloading, Drainage, Vibrofloatation, Sand drains and geosynthetic drains; Mechanical stabilization; Chemical stabilization; Thermal improvement methods; Stone columns; Grouting; Geosynthetics and other soil reinforcement methods; Soil nailing; Improvement by confinement; Effect of environment on soil properties; Case histories.

Ref book :

i. GI Technique – Dr. P.Purusattham Raj – Laxmi Publication

ii. Ground Improvement – Edited by Michael P.Moseley & Klaus Kirsh

iii. Ground Improvement - Case histories - Edited by Indraratna & J. Chu – Elsevier Publication

### **Airport Planning and Design**

**(3-1-0)**

Aircraft characteristics, obstruction criteria; air traffic control, runways: orientation, geometric standards, capacity, configuration, taxiway: geometric standards, fillets, high speed exit taxiway, apron-gate area and circulation, terminal building - functional areas and facilities, planning and site selection, pavement design and evaluation, visual aids, drainage, heliports

Reference Book:

(i) Airport Systems: Planning, Design, and Management by Richard de Neufville, Amedeo Odoni

(ii) Planning and Design of Airports by Robert Horonjeff, Francis McKelvey, William Sproule

(iii) Airport Engineering: Planning & Design by Saxena

(iv) Airport Planning & Design S.S. Jain, M.G. Arora, S. K. Khanna Published by Nem Chand & Brothers |

### **Structural Optimization**

**(3-1-0)**

Introduction and scope; Simultaneous failure mode and design; Classical external problems and calculus of variation, variational principles with constraints, linear programming, integer programming, nonlinear programming, dynamic programming, geometric and stochastic programming; Applications to structural steel and concrete members, trusses and frames, Design under frequency constraint, design of layouts.

Reference books:

(i) Elements of Structural Optimization- Raphael T. Haftka, Zafer Grdal, Springer Science & Business Media

(ii) An Introduction to Structural Optimization- Anders Klarbring Springer Science & Business Media

(iii) Advances in Structural Optimization- José Herskovits Springer Science & Business Media

## COMPUTATIONAL AND STATISTICAL METHODS

### Instructions (Hours/Week) Lectures 3-1-0

#### Module I

Numerical Solution of Ordinary Differential Equations-Solution by Taylors's Series-Euler's Method-Runge Kutta Methods-Simultaneous and Higher Order Equations-Boundary Value Problems-Applications.Finite Difference Method-Finite Difference. Representation of Differential Equations-Stability-Consistency and Convergence of Partial Differential Equations-Time integration-Finite Difference Methods in Solution of Steady and Unsteady Problem-Jacobi's Method, Gauss Seidel Method, Successive Over R Relaxation Method and Method of Characteristics-Application and Examples.

#### Module II

Finite Element Method-Basic Concepts – Solution of Discrete Problems-Steady State and Time Dependent Continuous Problems-Application of Finite Method through illustrative Examples.

Classification and Presentation of Data – Basic Concepts of Probability – Probability Axioms – Analysis and Treatment of Data – Population and Samples – Measures of Central Tendency – Measures of Dispersion- Measures of Symmetry – Measures of Peakedness.

#### Module III

Probability Distributions – Discrete and Continuous Probability Distribution Functions – Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distributions, Extreme Value Distributions – Transformations to Normal Distributions, Selecting A Probability Distribution, Parameter Estimation – Method of Moments, Method of Maximum Likelihood, Probability Weighted Moments and Least Square Method, Joint Probability Distributions.

#### Module IV

Regression Analysis – Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypotheses – Multiple Linear Regression – Correlation and Regression Analysis

#### References:

1. Akai, T.J,(1994) “Applied Numerical Methods for Engineers”, John Wiley Inc., New York
2. Haan C.T. (1995), “Statistical Methods in Hydrology”,. East West Press, New Delhi
3. Huyorkon, P.S. and Pinder, G.F.: “Computational Methods in Subsurface Flow”, Academic Press, 1983.
4. Press, W.H., Flannery B.P. and Tenklsky, S.A. and Vetterling, W.T. “Numerical Recipes-The Art of Scientific Computing”, Cambridge University Paress, Cmbridge, 1994.
5. Kosho, B (1997), “Neural Networks and Fuzzy Systems”, Prentice Hall of India, N Delhi
6. Rao V and H. Rao, (1996), “C<sup>++</sup> Neural Networks and Fuzzy Logic, BPB Publications, New Delhi”