SCHEME FOR M.TECH. CIVIL (GEOTECHNICAL ENGINEERING)
P G DEGREE COURSE

SEMESTER-1

Sr.No.	Course No.	Subject	Examination Schedule				Teaching Schedule				Time of Exams(Hrs)
			L	T	P/D	Total	Theory	Sessional	Practical	Total	
1	MCG 101	Engineering Properties of Soils	3	1	-	4	60	40	-	100	3
2	MCG 102	Earth Dams.& Slope Stability	3	1	-	4	60	40	-	100	3
3	MCG 103	Earth Pressure	3	1	-	4	60	40	-	100	3
4		**Departmental Elective-1**	3	1	-	4	60	40	-	100	3
5	MCG 104	Geotech Lab-I	-	-	4	4	-	40	60	100	
		Total	12	4	4	20	240	200	60	500	

SEMESTER-II

1	MCG -201	Foundation Engineering	3	1	-	4	60	40	-	100	3
2	MCG- 202	Soil Dynamics & Machine Foundations	3	1	-	4	60	40	-	100	3
3	MCG-203	Rock Mechanics.-I	3	1	-	4	60	40	-	100	3
4		**Departmental Elective-II**	3	1	-	4	60	40	-	100	3
5	MCG- 204	Geotech Lab -II	-	-	4	4	-	40	60	100	
		Total	12	4	4	20	240	200	60	500	

SEMESTER-1II

		Subjects	Examination Schedule L	T	P/D	Total	Teaching Schedule Theory	Sessional	Practical	Total	Time of Exam Hours
1	MCG- 301	Theoretical Soil Mechanics	3	1	-	4	60	40	-	100	3
2		**Departmental Elective-1II**	3	1	-	4	60	40	-	100	3
3	MCG-302	Seminar	-	-	1	1		100	-	100	1
4		Dissertation / Major Project Starts									

SEMESTER-1V

1	Dissertation, Evaluation & Viva Voce

* List of Electives for M.Tech. Civil (Geotechnical Engineering)

1. MCG – 401 Pavement Design
2. MCG – 402 flow Through Porous Media
3. MCG- 403 Clay Mineralogy
4. MCG- 404 Geotechnical Exploration and Advanced Soil Testing
5. MCG- 405 Rock Mechanics-II
6. MCG- 406 Case Histories in Geotechnical Engineering
7. MCG- 407 Computational & Statistical Methods

Grading for Dissertation

A > 85%

B = 75%-85%

C=60%-75%

D=50%-60%

* The candidates will opt for one of these electives in each of I, II, III Semesters, in such a way so as not to opt the same elective more than once.

MCG – 101 ENGINEERING PROPERTIES OF SOILS

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

General: Engineering Properties of natural soil deposits- Alluvial deposits, glacial deposits, aeolian, Loess and Residual Soils, Soil Profile, Soil moisture suction, suction plate method of determination, Effective stresses-Bishop's & Lambe's concepts, Sensitivity & thixotropic characteristics of clays.

Permeability & Seepage: Determination of Coefficient of Permeability by Parallel tube capillary model, Hydraulic radius model and other empirical relations, Seepage through Earth dam- Dupuit's solution, Schaffernak, Casagrande's and Pavlovsky's solution, seepage through dams under anisotropic conditions.

Shear Strength: Various types of triaxial tests- compression and extension, drainage conditions, Measurement of shear strength- Measurement and application of load, cell pressure, pore water pressure, and application of back pressure in a drained test, ϕ Parameter in sands, Energy correction, Skempton's Pore Pressure parameters and their determination. Shear strength of partially saturated soils, Hvorslev Parameters, stress paths- Lambe's and Rendulic- Henkel unique stress paths & their characteristics, relation of undrained shear strength and effective overburden pressure.

Consolidation: Characteristics of NC & OC clays, Reconstruction of field virgin compression curve for NC & OC clays Schmertmann correction, secondary consolidation, three dimensional consolidation, Sand drains.

Behaviour of compacted soils: General, effect of compaction on structure, swelling pressure, shrinkage, shear strength, p.w.p. & permeability. Comparison of dry and wet of OMC.

Books Recommended:

1. Principles of Soil Mechanics by Scott.
2. Foundation Engineering edited by Leonards.
3. Soil Mechnics by Lambe and Whitman.

MCG – 102 EARTH DAMS & SLOPE STABILITY

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

General: Purpose of earth dams, methods of construction, types of earth dams, materials required for earth dam construction, causes of failure of earth dams, design criteria for earth dams, suitable section for an earth dam, rockfill dams.

Seepage Analysis: General, phreatic line in earth dams and its location by various methods, problem of seepage control in earth dams-control of seepage through embankment, adverse effects of seepage, methods of seepage control, impervious core, selection of core material, core thickness, location of core in earth dam, selection and design of transition filters, rock toe, horizontal drainage, chimney drains, control of seepage through foundations-various options, upstream impervious blanket, Bennet's analysis for blanket length, relief wells, related problems.

Stability Analysis: Shear strength of soils, pore pressure in earth dams, various conditions of stability analysis for earth dams, methods of slope stability analysis, related problems.

Drainage: Gravity drainage, vacuum and osmotic drainage.

Instrumentation: Necessity, pore pressure measurement, vertical movement devices, horizontal movement devices, choice of instrumentation, instrumentation problems.

Books Recommended:

1 Earth and Rockfill Dams by Sherrad
2 Earth and Rockfill Dams by Bharat Singh & H.D.Sharma

MCG – 103 EARTH PRESSURE

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Earth Retaining Structures: Definitions, uses of retaining walls, types of retaining walls, rockfill drains, stability considerations for retaining walls.

Earth Pressure due to Cohesionless Soil: Trial Wedge Method, Coulomb's method, Rankine's method, Culmann's graphical construction, Poncelet's construction, friction circle method.

Earth Pressure due to Cohesive Soil: Trial Wedge method, friction circle method, circle of stress method.

Anchored Bulkheads: Sheet pile structures, cantilever sheet piles, anchored bulkheads.

Arching Action in Soils: Theory of arching, Cain's theory, braced excavation, earth pressure against bracing in cuts, heave of bottom of cut in soft clay, deep cut in sands.

Earth Pressure in Underground Conduits.

Books Recommended:

1 Earth Pressure & Retaining Walls by Huntington
2 Earth Pressure & Retaining Structures by Tschebatorioff
3 Analysis and Design of Foundations & Earth Retaining Structures by Shamshe Prakash, Gopal Ranjan, Swami Saran

MCG – 201 FOUNDATION ENGINEERING

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Shallow Foundation: Introduction, factors deciding depth of foundation, effect of water table on bearing capacity, points of difference between Rankine's, Terzaghi's, Meyerhof's, Skempton's bearing capacity theories, footings on slopes, footings with eccentric and inclined loads, bearing capacity of footings on layered soils, bearing capacity from SPT, SCPT, DCPT, bearing capacity of foundation with uplift forces, bearing capacity of rafts on sands and clays, distribution of contact pressure, plate load test and interpretation, settlement of footings, immediate and consolidation settlement, settlement from SPT and SCPT, settlement by Schmertann approach, computation of immediate settlement.

Pile Foundations: Uses of piles, static methods of pile load capacity, negative skin friction, group action in piles, pile load test, cyclic pile load test, computation of settlement of pile group, piles subjected to lateral loads, dynamic formulae to calculate the load on piles.

Caisson: Introduction, static method to find out load carrying capacity in sands and clays, design of open caisson, types of caissons and their advantages and disadvantages, forces acting on well foundations, stability of well foundations, IS recommendations for tilts and shifts.

Foundations on Difficult Sub-soils: Collapsible soil, physical parameters for identification, procedure for calculating collapse settlement, foundation design for soils not susceptible and susceptible to wetting, expansive soils, identification, swell potential and swell pressure, methods of foundations on expansive soils, replacement of soil and CNS concept, construction on expansive soils, sanitary landfills, under-reamed piles - applications, static formulae to calculate under- reamed pile capacity.

Cofferdams: Various types, their applications, design and lateral stability of braced cofferdam, design and stability of cellular cofferdams.

Books Recommended:

1. Principles of Foundation Engineering by B.M.Das.
2. Foundation Engineering by Bowles
3. Foundation Engineering by Leonards
4. Foundation Engineering by Peck, Hansen, Thornburn

MCG – 202 SOIL DYNAMICS & MACHINE FOUNDATIONS

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Theory of Vibrations: Definitions, Nature of dynamic loads, Characteristic elements of a vibrating system, properties of harmonic motion, analysis of single degree freedom system with undamped free vibrations, damped free vibrations, undamped forced vibrations, damped forced vibrations, logrithmic decrement, frequency dependent excitation force, determination of viscous damping, principle of vibration measuring instruments, transmissibility, systems with two-degrees of freedom(vibration absorber),Rayleigh's method of determination of fundamental frequency of a multi-degree freedom system, systems under transient forces.

Dynamic Stress Deformation and Strength Characteristics of Soils: Dynamic soil testing techniques, special requirements of apparatus for dynamic tests, Pendulum loading apparatus, oscillatory simple shear test, resonant column apparatus, field tests, stress deformation and strength characteristics of saturated sands and cohesive soils under pulsating loads.

Dynamic Earth Pressure Problems: Modification of Coulomb's theory and Culmann's construction for dynamic loads, analytical solutions for c -ϕ soils, point of application, displacement analysis, Indian Standard Code of Practice.

Dynamic Bearing Capacity: Earthquake Loads on footings, effect of horizontal load and moment, dynamic analysis of vertical and horizontal loads

Liquefaction of Soils: Theory of liquefaction, criteria of liquefaction, factors affecting liquefaction characteristics, laboratory studies on liquefaction, evaluation of liquefaction potential of a soil deposit, vibration table studies, liquefaction analysis from SPT data, anti-liquefaction measures.

Machine Foundations: Types of Machines and Machine Foundations, Criteria for satisfactory action of a machine foundation, methods of analysis, degrees of freedom of a block foundation, Barken's soil spring constants and their determination, analysis of a block foundation by Barken's theory and elastic half space theories, IS for design and construction of foundations for reciprocating machines, foundation for impact machines, IS for design and construction for impact machine, introduction to T.G. foundations,

Vibration isolation: Active isolation, passive isolation, methods of active and passive isolation, wave screening, vibration absorbing materials, planning for vibration isolation.

Books Recommended:

1 Dynamics of Bases and Foundations by D.D.Barken
2 Soil Dynamics by Shamsher Prakash
3 Soil Dynamics and Machine Foundations by Swami Saran
4 Analysis and Design of Foundations for Machines by Shamsher Prakash & V.K.Puri
5 Vibration and Shock Isolation by Crede
6 Vibration Analysis and Foundation Dynamics by Kameswara Rao
7 Handbook of Machine Foundations by Srinivasalu & Vaidyanathan
8 Principles of Soil Dynamics by B.M. Das.

MCG – 203 ROCK MECHANICS - I

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Introduction: Importance of Rock Mechanics, Composition of rocks, geological classification of rocks, classification of rocks for engineering purposes, RQD method of classification of rocks.

Laboratory Testing of Rocks: Various methods of obtaining rock cores, methods of sample preparation, effect of specimen geometry on rock strength determination, compression testing machine, uniaxial compressive strength of rock samples, factors affecting compressive strength, methods of finding tensile strength-direct and indirect methods, flexural strength test, shear strength tests-direct shear test, torsion test, shear box test, punch test, triaxial shear test.

In-situ Testing of Rocks: Field direct shear test on rock blocks, field triaixal strength, use of flat jacks, chamber test, plate load test, cable jacking test.

Stress Evaluation in Field: Stress relief technique(over coring), use of strain gauges, bore hole deformation cell, LVDT, photo-elastic stress meter, stress measurement with flat jack, typical results of evaluation, dilatometer, hydraulic fracturing techniques, uses and advantages.

Elastic and Dynamic Properties of Rocks: Static elastic constants of rocks and their determination, stress-strain behaviour, dynamic properties of rock mass, methods of finding dynamic properties.

Pressure on Roof of Tunnels: Terzaghi's theory, Bieraumer's theory, Kommeral theory, Protodyakanov theory, Kastner's theory, Labasse's theory.

Books Recommended:

1 Rock Mechanics Vol. I, II, III, IV by Lama et.al.
2 Fundamentals of Rock Mechanics by Jaegar and Cook
3 Rock Mechanics by Stagg & Zienkiewiez
4 Art of Tunnelling by Schzy

MCG – 301 THEORETICAL SOIL MECHANICS

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Fundamental Relations: Concept of stress, concept of strain, rotation of axes, principal stresses and strains, invariants, Octahedral stresses and strains, equations of equilibrium, equations of equilibrium in polar coordinates, stress-strain relations, generalised Hooke's law, two-dimensional analysis, plane stress case, plane strain case, equation of compatibility in terms of stress components and Airy's stress functions, Mohr's diagram, problems.

Stresses and Displacements in Soil Mass as an Elastic Body: Line load(two dimensional case), vertical, horizontal and inclined line loads on semi-infinite systems, distributed line loads(two dimensional), uniform normal load over a strip, normal load over a circular and rectangular area, triangular and other loadings.

Settlement and Consolidation: Finite Difference Method, Relaxation Method, Numerical Solution of one dimensional consolidation equation, problems.

Stability of Soil Structures: Soil strength, conventional methods, effect of wall movement on lateral earth pressure(Dubrova's method), various cases, effect of surcharge on lateral earth pressure.

Limiting Equilibrium of Soil Structures: Dimensional similitude, fundamental concepts and relations, Sokolovsky's equation for characteristic lines, solution procedures, bearing capacity, stability of slopes.

Book Recommended:

Fundamentals of Theoretical Soil Mechanics by Harr

MCG – 401 PAVEMENT DESIGN

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Introduction: Types of pavements, components of a flexible and a rigid pavement, Design strategies, comparison of Highway and airport pavements, Design approaches, Factors affecting pavement design.

Stresses in Flexible Pavements: Layered system concept, Multilayaer system, one layer systems, two-layer systems, deflections, Influence of type pressure, total load and c/c spacing, ESWL by equal stress and equal deflection, three layer systems.

Design of Flexible Pavements: Various design methods, CBR method, Current Indian practice, triaxial Method, Burmistser's method, AASHO method, Haveem or California Resistance Value method, National Crushed Stone Association (USA) method.

Stresses in Rigid Pavements: Stresses due to load, Westergaard's theory, stresses due to temperature change, combined loading and temperature stresses, effect of tyre pressure, total load and wheel configuration, joints & their various types.

Design of Rigid Pavements: Current Indian Practice, spacing of expansion and contraction joints, design of temperature Reinforcement, Dowel Bars and Tie bars.

Pavement Evaluation and Strengthening: Structural evaluation by Bankelman Beam Method, Present Serviceability rating and present Serviceability Index, Types of overlays Design of overlays. Current Indian Practice in the design of overlays.

Structural Design of Airport Pavements: Design factors, various methods of design. CBR method, Mcleod method, LCN method.

Book Recommended:

Principles of Pavement Design by Yoder and Witczak

MCG – 402 FLOW THROUGH POROUS MEDIA

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

hrs.

Basic Principles: Darcy's Law, Permeability and its field determination, equation of continuity, velocity potential, stream function Laplace's equation.
Solution of Laplace's Equation: Solution by graphical method, flow nets in homogeneous soils, anisotropic soils and layered soils, computation of seepage quantity, seepage pressure, uplift pressure on structures, exit gradient, piping due to subsurface erosion and heave. Two and three dimensioned electrical analogy method, relaxation method.

Seapage through Earth Dams: Determination of phreatic line, Dupuit's solution, Casagrande's solution, Kozeney parabola, entrance and exit corrections, flow nets for zoned earth dams and earth dams on pervious foundations under steady seepage conditions, flow nets for homogeneous sections under sudden drawn down, introduction to control of seepage, filters -type, selection and design.

Solution by Mapping Techniques: Conformal mapping of elementary function, Kozeney's basic parabola, Schwarez-Christoffel transformation, Khosla's solution, Velocity hydrograph, flow characteristics at singular points, examples of velocity hydrograph, solution by complex velocity, solution of triangular dam.

Seepage in Foundations: Construction dewatering-Methods of dewatering, Design of dewatering for foundation exacavations, foundation improvement by drainage, drainage in retaining structures, influence of seepage on stability of slopes, drainage methods for stability of slopes.

Book Recommended:

1. Harr, M.E. " Ground Water & Seepage"
2. Cedergren "Seepage, Drainage & Flownets"

MCG – 403 CLAY MINERALOGY

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Introduction: Definitions, factors affecting properties of clay materials, inter-atomic bonding, secondary bonds.

Classification and Structure of Clay Minerals: Basic lattice structure, structural units of clay minerals, basic structure of silica, classification of clay minerals, Isomorphous substitution, inter sheet and inter layer bonding in clay minerals, the 1:1 minerals, montmorillonite minerals, mica-like clay minerals, chlorite minerals, chain structure clay minerals, mixed layer minerals, non-crystalline clay minerals.

Origin and Occurrence of Clay Minerals: Process and agents of weathering, formation of clay minerals, origin and occurrence of various clay minerals.

Identification of Clay Minerals: Differential thermal analysis, X-ray diffraction analysis, optical microscope studies of soils, electron microscope studies, shape and size of clay minerals.

Clay-Water: Influence of dissolved ions, possible mechanism of clay-water interaction, evidence on the structure and properties of adsorbed water.

Clay-Water Electrolyte Systems: Ion distribution in clay-water systems, cation exchange, cation exchange capacity, theories of ion exchange, anion exchange, engineering significance of base exchange.

Effect of Clay Minerals on Soil Properties: Effect on Atterberg limits, shrinkage and swelling characteristic, compressibility, soil structure, permeability, strength and deformation behaviour.

Books Recommended:

1 Fundamentals of Soil Behaviour by J.K.Mitchell
2 Applied Clay Mineralogy by Grim
3 Clay Mineralogy by Grim

MCG – 404 GEOTECHNICAL EXPLORATION AND ADVANCED SOIL TESTING

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

General: Purpose of soil exploration, preliminary investigations, site reconnaissance, phasing of soil exploration.

Excavation and Boring Methods: Exploration by pits, trenches, drifts and shafts, augur boring, shell and augur boring, wash boring, percussion drilling, rotary drilling, coring bits, shot core boring, stabilization of bore holes.

Sampling Techniques: Sample disturbance, type of soil samples, design features of sampler affecting sample disturbance, type of samplers, open drive samplers - thin wall, thick wall and split spoon samplers, rotary sampler, rock core drilling, core catcher, sampling from test pits, procuring and handling of disturbed and undisturbed samples.

Subsurface Soundings: Standard penetration test (SPT), static cone penetration test (SCPT), dynamic cone penetration test (DCPT), pocket penetrometer, Jodhpur penetrometer.

Geophysical Methods: Seismic refraction method, electrical resistivity method - resistivity sounding and resistivity profiling, magnetic method, gravitational method.

Recent Trends in subsurface exploration, important role of remote sensing, comparison with conventional methods.

Advanced Testing Techniques: In -situ shear test, shear box test, bore hole shear test, field vane shear test, in-situ permeability tests, pressure meter test, flat dilatometer test,field plate bearing test, dynamic tests, oedometer tests, special triaxial tests, soil expansivity tests - swell pressure, swell potential, differential free swell.

Planning and Execution of Sub-soil Exploration Programme: Depth and lateral extent of exploration for different Civil Engineering Works, selection of rig and sampling equipment, ground water observation, field tests vis-à-vis lab tests, deployment of personnel and equipment, bore logs, soil investigation report, planning of exploration and testing programme for different field projects.

Books Recommended:

1 Soil Engineering in Theory and Practice, Vol. II, Geotechnical Testing and Instrumentation by Alam singh

2 Soil Mechanics and Foundation Engineering, Vol. II, (Foundation Engineerin by V N S Murthy

3 Foundation Analysis and Design by Bowles

4 Principles of Foundation Engineering by B M Das

5 Foundation Engineering by Brahma

6 The Measurement of Soil Properties in the Triaxial Test by Bishop and Henkel

MCG – 405 ROCK MECHANICS - II

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Strength and Failure of Rocks: Types of failure, theories of failure- Coulomb - Navier theory, Mohr's theory, fracture of jointed rocks in uniaxial compression, crack phenomenon and mechanism of failure, Griffith's two dimensional theory of cracks, elementary theory of crack propagation, strain energy associated with cracks, dynamics of crack propagation, modified Griffith's brittle fracture criterion.

Rock Blasting and Explosives: Explosives, uses, types, properties, composition of high explosives, choice and quality of explosives, mechanism of detonation, breaking ground with explosives, blasting theory, calculation of burden distance, factors involved in blasting, blast hole diameter, quarry blasting practice.

Rocks Slope Stability: Rock slope, mechanism of failure, shape of failure zone, criteria of rock stability, geological considerations, block sliding, principles of design of slopes.

Stabilization of Rocks: Rock bolting, principles of rock bolting, types and applications of rock bolt, rock grouting, grouting materials, grouting operations, methods of grouting, guniting.

Stress around Tunnels and under Ground Openings under various loading conditions, effect of number of tunnels and shape of tunnels, design of pressure tunnels in rocks.

Creep of Rocks: time dependents properties of rock.

Books Recommended:

1 Rock Mechanics Vol. I, II, III, IV by Lama et.al.
2 Fundamentals of Rock Mechanics by Jaegar and Cook
3 Rock Mechanics by Stagg & Zienkiewicz
4 Art of Tunnelling by Schzy

MCG – 406 CASE HISTORIES IN GEOTECHNICAL ENGINEERING

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Case studies of shear failure and settlement failure of foundations e.g. foundation distress of Leaning Tower of Pisa, Transcona Grain Elevator, Settlement of Mexico City etc..

Case studies of foundation failure and seepage failure of earth dams e.g. Panchet Dam(Maharashtra), Nanak Sagar Dam, Sampna Dam, Ahroura Dam, Vaiont Reservoir Disaster, Fort Peck Dam Slide etc.

Case studies of failures due to liquefaction of soils during earthquake e.g. failures during Kobe Earthquake in Japan etc.

Case studies of landslides , landslips and other slope failures .

Case studies of retaining wall failures.

Books Recommended :

1 Earth and Rockfill Dams by Bharat Singh & H.D.Sharma
2 Soil Mechanics by Perloff & Baron
3 Soil Mechanics & Foundation Engineering by Oza

MCG – 407 COMPUTATIONAL AND STATISTICAL METHODS

L	T	P/D	Total
3	1	-	4

Max. Marks: 100
Theory: 60 Marks
Sessionals: 40 Marks
Duration 3 hrs.

Numerical Solution of Ordinary Differential Equations: Solution by Taylor'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 Relaxation Method and Method of Characteristics – Application and Examples.

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.

Probability Distribution: Discrete and Continuous probability Distribution Functions – Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distribution, Extreme Value Distribution - 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.

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

Books Recommended:

1. Applied Numerical Methods for Engineers by Akai
2. Statistical Methods in Hydrology by Haan
3. Computational Methods in Subsurface Flow by Huyorkon, Pinder
4. Numerical Recipes – The Art of Scientific Computing by Press, Flannery, Tenklsky, Vetterling