## BRANCH-CIVIL ENGINEERING

**2nd Semester**

***Specialization: Structural Engineering/ Structural and Foundation Engineering***

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Practical** | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Advanced Reinforced Concrete Design | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Matrix Methods of Analysis of Structure | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Structural Dynamics 2.Advanced Steel Structure 3. Bridge Engineering 4.Earthquake Resistance Design of Structure | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1.Advance Construction Materials 2. Offshore Engineering 3. Tall Structures 4.Optimization Methods & its Application in Civil Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

## BRANCH-CIVIL ENGINEERING

**2nd Semester**

***Specialization: Water Resource Engineering & Management/ Water Resource Engineering***

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Practical** | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Ground Water Hydrology | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Free Surface Flow | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Advanced Fluid Mechanics 2. Applied Hydrology 3.Fluvial Hydaulics 4. Ground Improvement Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1. Design of Irrigation Structure 2. GIS & Remote Sensing 3. Irrigation & Drainage 4.Water Resources System & Management | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

## BRANCH-CIVIL ENGINEERING

**2nd Semester**

***Specialization: Transportation Engineering***

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Practical** | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Geometric Design of Highways | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Transportation Systems Planning | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Advanced Railway Engineering 2.Planing & Design of Airport 3. Bridge Engineering 4.Ground Improvement Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II(Departmental related)*** 1.Advance Construction Materials 2. Mass Transit Systems 3. Traffic Engineering & Traffic Flow Theory 4.Transportation & Environment | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

## BRANCH-CIVIL ENGINEERING

**2nd Semester**

***Specialization:** Soil Mechanics and Foundation Engineering/ Soil Mechanics*

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Theory | | | | Practical | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Advanced Soil Mechanics | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Ground Improvement Technique | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Stability Analysis of Slopes, embankments & Dams 2.Ground Water & Flow Through Porous Media 3.Earth Retaining structure 4.Earthquake Geotechnical Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1.Subsoil Exploration & Soil Testing 2. Dynamics of Soils & Foundation 3.Strength & Deformation Behavior of Soil 4.Optimization Methods & its Application in Civil Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III (from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

## BRANCH-CIVIL ENGINEERING

**2nd Semester**

***Specialization: Geotechnical Engineering***

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Practical** | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Advanced Geo-Mechanics | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Ground Improvement Technique | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Stability Analysis of Slopes, embankments & Dams 2.Ground Water & Flow Through Porous Media 3.Rock Mechanics 4.Soil Dynamics & Geotechnical Earthquake Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1. Subsoil Exploration & Soil Testing 2. Soil Stabilization by Admixture 3.Reinforced Soil Structure 4.Optimization Methods & its Application in Civil Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

# DETAILED SYLLABUS OF SECOND SEMISTER M.TECH 2016-17 ADDMISSION BATCH

## BRANCH-CIVIL ENGINEERING

### *Specialization: Geotechnical Engineering*

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Theory | | | | Practical | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Advanced Geo-Mechanics | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Ground Improvement Technique | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Stability Analysis of Slopes, embankments & Dams 2.Ground Water & Flow Through Porous Media 3.Rock Mechanics 4.Soil Dynamics & Geotechnical Earthquake Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1. Subsoil Exploration & Soil Testing 2. Soil Stabilization by Admixture 3.Reinforced Soil Structure 4.Optimization Methods & its Application in Civil Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

# ADVANCED GEOMECHANICS

**Module I**

Soils, rocks and groundwater: geology and genesis of soils, principle of effective Stress, indices and phase relationships, groundwater flow.

**Module II**

Stress and strain analysis: Mohr circles, failure criteria, soil laboratory tests,

**Module III**

Shear strength and stiffness of sands: stress-strain, volume change and shearing in sands, critical state and stress paths, consolidation,

**Module IV**

Shear strength and stiffness of clays: compression and consolidation, drained and un-drained shear strength, critical state and stress paths.

**References:**

1. Wood, D.M., Soil Behaviour and Critical State Soil Mechanics, Cambridge University Press, 1991.
2. Bolton, M.D., A Guide to Soil Mechanics, Cambridge University Press, 1991.
3. Salgado, R., The Engineering of Foundations, McGraw Hill, 2008.
4. Atkinson, 'Critical State Soil Mechanics'

# GROUND IMPROVEMENT TECHNIQUES

**Module I**

Principles of ground improvement. Mechanical modification, properties of compacted soil, compaction control tests.

**Module II**

Hydraulic modification, dewateringsystems, filtration, drainage and seepage control with geo-synthetics, preloadingand vertical drains, Electric-kinetic dewatering, chemical modification.

**Module III**

Modificationby admixtures, stabilization using industrial wastes, grouting, modification byinclusion and confinement, soil reinforcement, flexible geo-syntheticsheet reinforcement, anchorage.

**Module IV**

Reinforcement techniques, bearing capacity improvement, slope stability, retaining walls and pavements.

## References

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw Hill,1990.
2. Jones, C.J.E.P., Reinforcement and Soil Structures, ButterworthPublications, 1996.
3. Koerner, R.M., Designing with Geosynthetics, Prentice Hall Inc. 1998.

# STABILITY ANALYSIS OF SLOPES, EMBANKMENTS AND DAMS

**Module I**

Landslide phenomenon: Types and causes of slope failures, Practical applications; Stability analysis of infinite slopes with or without water pressures;

**Module II**

Stability analysis of finite and infinite slopes: concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method; Method ofslices, Bishop's method, Janbu's method;

**Module III**

Effect of seepage, submerged and sudden draw down conditions; Design of slopes in cutting, Embankments and Earth dams;

**Module IV**

Site Investigation: Reconnaissance, Preliminary and detail investigation, Investigation for foundations; Advances in stability analysis of slopes.

**References**

1. L. W Abramson, T. S Lee, S Sharma and G M Boyce, Slope Stability and Stabilization Methods, Willey Inter science publications
2. B M Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole
3. T W. Lambe and R V Whitman, Soil Mechanics, John Wiley & sons
4. V N S Murthy, Principles of Soil Mechanics and Foundation Engineering, UBS Publishers Private Ltd.

# GROUND WATER AND FLOW THROUGH POROUS MEDIA

**Module I**

Soil Water: Modes of occurrence of water in soils. Adsorbed water, capillary water, Capillary potential, capillary tension and soil suction. Effective and Neutral pressures in soil;

**Module II**

Flow through porous Media: Darcy's law and measurement of permeability in laboratory and field. Steady State flow solutions of Laplace's equation, Plane problems, 3-dimensional problems, Partial cut-offs, uplift pressure,

**Module III**

Consolidation theory: one and three dimensional consolidation, Secondary consolidation.

**Module IV**

Ground water Hydraulics: Water table in regular materials, Geophysical exploration for locating water table. Confined water, Equilibrium conditions, Non-equilibrium conditions, Water withdrawal from streams, Method of ground water imaging.

**References:**

1. D.K.Todd, Groundwater Hydrology, John wiley and Sons
2. H. M. Raghunath, Ground Water, Willy Eastern Ltd.
3. C. Fitts, Ground Water Science, Elsevier Publications, U. S. A.
4. P. P. Raj, Geotechnical Engineering, Tata McGraw-Hill
5. A. Jumikis, Soil Mechanics, East West Press Pvt Ltd.

# ROCK MECHANICS

**Module I**

Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses, Static Elastic constants of rock;

**Module II**

Rock Testing: Laboratory and Field tests; Discontinuities in Rock Masses: Discontinuity orientation, Effect of discontinuities on strength of rock;

**Module III**

Strength Behaviour: Compression, Tension and Shear, Stress-Strain relationships, Rheological behaviour; Strength/ Failure Criterion: Coulomb, Mohr, Griffith theory of brittle strength and other strength criteria. Stresses in rock near underground openings;

**Module IV**

Application of rock mechanics in Civil Engineering: Rock tunnelling, Rock slope stability, bolting, blasting, grouting and rock foundation design.

**References**

1. W. Farmer, Engineering Behaviour of Rocks, Chapman and Hall Ltd.
2. R. E. Goodman, Introduction to Rock Mechanics
3. P.R. Sheorey, Empirical Rock Failure Criteria, Balkema, Rotterdam, 1997
4. V.S. Vutukuri and R D Lama, Hand Book on Mechanical Properties

# SOIL DYNAMICS AND GEOTECHNICAL EARTHQUAKE ENGINEERING

**Module I**

Soil Dynamics: Introduction: Soil mechanics and soil dynamics, problems of dynamic loading on soil structure.
Theory of vibrations: Introduction, definitions, properties of simple harmonic motion, free vibrations of spring mass system, Equations for free and forced vibrations with and without viscous damping.

**Module II**

Dynamic Soil Properties: Introduction, measurement of dynamic soil properties (laboratory and field tests - Stress and strain controlled cyclic triaxial tests, seismic reflection and refraction test, seismic up-hole/down hole test, dilatometer and pressure meter tests, seismic cone penetration test, suspension logging test), stress-strain behaviour of cyclically loaded soils, strength of cyclically loaded soils.

**Module III**

Geotechnical Earthquake Engineering: Introduction, background, seismic hazards; ground shaking, structural hazards, liquefaction, landslides, lifeline hazards, tsunami hazards, mitigation of seismic hazards, significant historical earthquakes. Seismology and earthquakes: Internal structure of the earth, continental drift and plate tectonics, faults, elastic rebound theory, other sources of seismic activity location of earthquakes, size of earthquakes (intensity, magnitude and energy).
Seismic Liquefaction: Introduction, Flow liquefaction and cyclic mobility, liquefaction susceptibility (historical, geologic, and compositional). Initiation of liquefaction due to excess pore water pressure, effects of liquefaction (alteration of ground motion, development of sand boils, settlement and instability).

**Module IV**

Bearing Capacity Analysis: Introduction, punching shear failure approach for cohesive and cohesion-less soils, Terzaghi's method for both cohesion-less and cohesive soils.
Ground Improvement Techniques for Remediation of seismic hazards: introduction, densification techniques (Vibro-technique, dynamic compaction, blasting, grouting and mixing and drainage techniques).

**References:**

1.Geotechnical Earthquake Engineering by Steven L. Kramer, Low Price Edition,Pearson Education, www.pearsoned.co.in
2. Soil Dynamics by Shamsher Prakash, McGraw-Hill Book Company
3. Soil Behaviour in Earthquake Geo-technics by Kenji Ishihara, Clarendon Press, Oxford
4.Theory of Vibrations with Applications by W. T. Thomson and M. D. Dahleh,Low Price Edition, Pearson Education, www.pearsoned.co.in

## Subsoil Exploration & Soil Testing

**Module-I**

Problems and phases of foundation investigations: Geophysical sounding, drilling and accessible explorations.

**Module-II**

Sample requirements, sampling methods and equipment. Handling, preservation and transportation of samples.

**Module-III**

Sample preparation, laboratory tests, analysis of results and interpretation, importance of in-situ testing.

**Module-IV**

Performing various in-situ tests. Precautions and interpretation, site evaluation and reporting, block vibration test.

**References:**

1. Head, K.H., Manual of Soil Laboratory Testing, Vols. 1 to 3, 1981.

2. Compendium of Indian Standards on Soil Engineering, Parts 1 and II, 1987– 1988.

# SOIL STABILISATION BY ADMIXTURES

**Module I**

Principles of soil stabilization, role of admixtures, purpose based classification of soils.

**Module II**

Methods of stabilization – lime, cement, bitumen and special chemicals, mechanisms, uses and limitations.

**Module III**

Use of fly ash and other waste materials.

**Module IV**

Methods and applications of grouting. Application to embankments, excavations, foundations and sensitive soils.

**References:**

1. Ingles, O.G., and Metcalf, J.B., Soil Stabilization, Principles and Practice,Butterworths, 1972.
2. Bowen, R., Grouting in Engineering Practice, Allied Science Publishers Ltd.,1975.

# REINFORCED SOIL STRUCTURES

**Module I**

PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT
Historical Background, Principles, Concepts and Mechanisms of reinforced earth.

REINFORCING MATERIALS AND THEIR PROPERTIES
Materials used in reinforced soil structures, fill materials, reinforcing materials metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites and Geojutes, Geofoam, Natural fibres - facing elements – Properties and methods of Testing.

**Module II**

DESIGN OF SOIL REINFORCEMENT
Reinforcing the soil-Geotextiles and Geogrids – Embankments and slopes – reinforced walls – bearing capacity – Road way reinforcement – slop stabilization.

**Module III**

DESIGN FOR SEPARATION, FILTRATION AND DRAINAGE
Geotextiles - requirement for design of separation – Filtration – General behaviour - Filtration behind retaining wall, under drains, erosion control and silt fence – drainage design – Liners for liquid containment – Geomembrane and Geosynthetic clay liners.

**Module IV**

DURABILITY OF REINFORCEMENT MATERIALS
Measurement of corrosion factors, resistivity - redox potential, water content, pH, Electrochemical corrosion, bacterial corrosion – influence of environmental factors on the performance of Geosynthetic materials.

**REFERENCES:**

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
2. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.
3. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
4. Muller, W.W. HDPE Geomembranes in Geotechnics, Springer, New York2007.
5. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.
6. Gray, D.H., and Sotir, R.B., Biotechnical and Soil Engineering SlopeStabilization: Apractical Guide for Erosion control, John Wiley & Son Inc. New York, 1996.
7. RamanathaAyyar , T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N.,Comprehensive Reference Book on Coir Geotextile, Centre for Developmentfor Coir Technology, 2002.
8. Siva Kumar Babu, G.L., An Introduction to Soil Reinforcement and Geosynthetics University Press (India), Pvt. Ltd., Hyderabad, 2006.

# OPTIMIZATION METHODS AND ITS APPLICATIONS IN CIVIL ENGINEERING

**Module I**

Introduction: Need for engineering optimal design, Optimum design formulation: Design variable, objective function and constraints; unconstrained optimization methods Single variable optimization methods: Region elimination method – Golden Section search, Interval halving method; Gradient based method – Newton-Raphson, bisection and secant method.

**Module II**

Multi variable optimization methods: Direct search method: Hooke-Jeeves pattern search, simplex reflection search, Powell's conjugate direction search. Gradient Based methods: Cauchy's steeped descent, Newton's method, Levenberg Marquardt's method, Fletcher- Reeve method; constrained optimization methods Kuhn Tucker condition, Penalty function method, Augmented Lagrangian method, sequential unconstrained minimization, cutting plane method;

**Module III**

Introduction to Evolutionary algorithms: Need for evolutionary algorithms, Type of evolutionary methods, Introduction to Genetic algorithm (GA), Difference and similarities between GA and traditional methods. Basic operations of GA: reproduction, crossover, mutation and elitism. Binary coded and real coded GA;

**Module IV**

Application of Optimization techniques: Water resource planning management, Structural Optimization, Transportation planning and Management, Slope stability and optimal dimensioning of foundations. Multi-objective optimization models.

**References**

1. J.S. Arora, Introduction to Optimum Design, Elsevier, 2nd Edition, 2004.
2. K. Deb, Optimization for Engineering. Design: Algorithms & Examples, Prentice Hall India, 2006
3. S.S. Rao, Engineering Optimization: Theory & Practice, New Age International (P) Ltd, 3rd Edition, 1996, Reprint: June, 2008
4. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley, 2003

# COMPOSITE STRUCTURES

**Module I:**

Introduction: definition and characteristics, fibres, matrices, fibre reinforced composites, advantages and limitations, basic concepts and characteristics: isotropy, orthotropic, classification, lamina and laminate, micromechanics and micromechanics, constituent materials and properties.

**Module II:**

Elastic behaviour of unidirectional lamina: specially orthotropic and transversely isotropic material, relation between mathematical and engineering constants, stress strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, transformation of stress-strain relations in terms of engineering constants.

**Module III:**

Elastic behaviour of multidirectional laminates, symmetric and balanced laminates, design considerations, computational procedure for finding engineering elastic properties, stress and failure analysis of multidirectional laminates.

**Module IV:**

Bending of laminated composite plates, thin laminated plate theory, deflection of all edges simply supported rectangular symmetric cross-ply laminate, two opposite edges simply supported.

**Books:**

1. I.M. Daniel & O. Ishai, “Engineering Mechanics of Composite Materials", Oxford Press
2. S.W.Tsai&H.T.Hahn, "Introduction to Composite Materials: Techonomic Pub. Co.INC, USA.
3. P.K.Sinha,"A short term course on Composite Materials and Structures"-1996

# HYDRO POWER ENGINEERING

**Module I:**

Instruction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

**Module II:**

Classification of Hydel Plants: Run off river plants, general arrangement of run off river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three unit arrangement, reversible pump turbines, problems of operation, power house, efficiency of P-S plants.

**Module III:**

Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. Intakes: Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels. Turbines: Introduction, types of turbines, hydraulic features, turbine size, constructional features of turbines, layout arrangements, hydraulic of turbines, basic flow equations, draft tubes, cavitations in turbines, governing of turbines, characteristics of turbines, illustrative examples.

**Module IV:**

Power House Planning: Surface power stations: power house structure, power house dimensions, lighting and ventilation, variations in design of power house. Underground power station: Location of U.G. power station, Types of U.G. power stations, advantages of U.G. power house, components of U.G. power house, types of layout, limitations of U.G. power house structural design of power house. Tidal power: Basic principle, location of tidal power plant, difficulties in tidal power generation, components of tidal power plants, modes of generation, single basin arrangement, double basin system.

**References:**

1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
2. Irrigation and water resources Engg. By G.L. Asawa, New Age international Publishers.
3. Irrigation and water power Engineering by B.C. Punamia, Pande B.B. Lal (Laxmi Publications Private Limited)

# NON-CONVENTIONAL ENERGY

**Module I**

Introduction various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. 3 Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

**Module II**

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**Module III**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. 4 Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. 2 Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

**Module IV**

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. 2 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.

Bio-mass: Availability of bio-mass and its conversion theory. 2 Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

**References Books:**

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International. 5.
C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.

# ADVANCED NUMERICAL METHODS

**Module I:**

Introduction to digital computers & Programming - an overview; Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

**Module II:**

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods. Matrices – Linear equations, Eigenvalues and Eigenvectors - nonlinear equations,

**Module III:**

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

**Module IV:**

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

**Referrences**

1. Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg.Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
3. Gerld C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.
5. Johnson R.A " Probability and Statistics for Mngineers.
6. Rajeshwaran S, "Numerical Methods in Science & Engineering (A Practical Approach)",Willey Publication.

# Green Building Concepts

**Module I**

Environmental implications of buildings energy, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transporation Energy for Building Materials; Maintenance Energy for Buildings.

**Module II**

Implications of Building Technologies Embodied Energy of Buildings: Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

**Module III**

Comforts in Building: Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

**Module IV**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings. Unit V Green Composites for buildings: Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**TEXT BOOKS**

[1] K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
[2] Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
[3] Green My Home!: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint, by Dennis C. Brewer, ISBN:9781427798411, Publisher: Kaplan Publishing, Publication Date: October 2008.
[4] B. Givoni, Man, Climate and Architecture Elsevier, 1969.
[5] T. A. Markus and E. N. Morris Buildings Climate and Energy. Pitman, London, 1980. Arvind Kishan et al (Ed)
[6] Climate Responsive Architecture. TataMcGraw Hill, 2001.
[7] Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
[8] O. H. Koenigs Berger, T. G. Ingersoll, Alan Mayhew and S. V. Szokolay. Manual of Tropical Housing and Building. Orient Long man, 1975.

**REFERENCE BOOKS**

[1] Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
[2] Michael F. Ashby Materials and the Environment, Elsevier, 2009.
[3] Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
[4] Mili M. Ajumdar (Ed) Energy Efficient Building in India. Teri and Mnes, 2001/2002.
[5] T. N. Seshadri et al Climatological and Solar Data for India. CBRI and SaritaPrakashan, 1968. 34
[6] Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

[7] The New Solar Electric Home: The Photovoltaics How-To Handbook, by Joel Davidson, ISBN: 9780937948095, Publisher: Aatec Publications, Publication Date: July 1987.

## BRANCH-CIVIL ENGINEERING

***Specialization: Soil Mechanics and Foundation Engineering/Soil Mechanics***

| **Second Semester** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Theory** | | | | **Practical** | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Advanced Soil Mechanics | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Ground Improvement Technique | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Stability Analysis of Slopes, embankments & Dams 2.Ground Water & Flow Through Porous Media 3.Earth Retaining structure 4.Earthquake Geotechnical Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1.Subsoil Exploration & Soil Testing 2. Dynamics of Soils & Foundation 3.Strength & Deformation Behavior of Soil 4.Optimization Methods & its Application in Civil Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III (from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

# ADVANCED SOIL MECHANICS

**Module I**

Introduction: Origin of soil and its types, mineralogy and structure of clay minerals, X-ray and Differential Thermal Analysis; structure of coarse grained soil, behavior of granular and cohesive soils with respect to their water content

**Module II**

Consolidation: Steady State flow, 2D and 3D seepage, transient flow; Compressibility and rate of consolidation, one, two, and three dimensional consolidation theories; Sand drains

**Module III**

Critical state soil mechanics: Critical State Line, Hvorslev Surface, Yield Surfaces: Modified Cam-clay and Original Cam-clay; Elastic and plastic analysis of soil:- Constitutive relationships of soil; failure theories. Limit analysis-Upper bound theorems, lower bound theorems, limit equilibrium methods

**Module IV**

Soil Stabilization: Classification of stabilizing agents and stabilization processes. Nature and surface characteristics of soil particles. Concepts of surface area and contact points. Inorganic stabilizing agents. Strength improvement characteristic of soft and sensitive clay, Marine clay and waste material.

**References:**

1. B M Das, Advanced Soil Mechanics, Taylor and Francis
2. R F Scott, Principles of Soil Mechanics, Addison & Wesley.

# GROUND IMPROVEMENT TECHNIQUES

**Module I**

Principles of ground improvement. Mechanical modification, properties of compacted soil, compaction control tests.

**Module II**

Hydraulic modification, dewatering systems, filtration, drainage and seepage control with geosynthetics, preloading and vertical drains, Electri-kinetic dewatering, chemical modification.

**Module III**

Modification by admixtures, stabilization using industrial wastes, grouting, modification by inclusion and confinement, soil reinforcement, flexible geosysthetic sheet reinforcement, anchorage.

**Module IV**

Reinforcement techniques, bearing capacity improvement, slope stability, retaining walls and pavements.

## References

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw Hill,1990.
2. Jones, C.J.E.P., Reinforcement and Soil Structures, ButterworthPublications, 1996.
3. Koerner, R.M., Designing with Geosynthetics, Prentice Hall Inc. 1998.

# STABILITY ANALYSIS OF SLOPES, EMBANKMENTS AND DAMS

**Module I**

Landslide phenomenon: Types and causes of slope failures, Practical applications; Stability analysis of infinite slopes with or without water pressures

**Module II**

Stability analysis of finite and infinite slopes: concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method; Method of slices, Bishop's method, Janbu's method

**Module III**

Effect of seepage, submerged and sudden draw down conditions; Design of slopes in cutting, Embankments and Earth dams

**Module IV**

Site Investigation: Reconnaissance, Preliminary and detailed investigation, Investigation for foundations ; Advances in stability analysis of slopes.

**Text Books:**

1. L. W Abramson, T. S Lee, S Sharma and G M Boyce, Slope Stability and Stabilization Methods, Willey Interscience publications
2. B M Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole

**Reference Books:**

1. T W. Lambe and R V Whitman, Soil Mechanics, John Wiley & sons
2. V N S Murthy, Principles of Soil Mechanics and Foundation Engineering, UBS Publishers Private Ltd.

# GROUND WATER AND FLOW THROUGH POROUS MEDIA

**Module I**

Soil Water: Modes of occurrence of water in soils. Adsorbed water, capillary water, Capillary potential, capillary tension and soil suction.

**Module II**

Effective and Neutral pressures in soil; Flow through porous Media: Darcy's law and measurement of permeability in laboratory and field.

**Module III**

Steady State flow solutions of Laplace's equation, Plane problems, 3-dimensional problems, Partial cut-offs, uplift pressure, consolidation theory –one and three dimensional consolidation .

**Module IV**

Secondary consolidation; Ground water Hydraulics: Water table in regular materials, Geophysical exploration for locating water table. Confined water, Equilibrium conditions, Non-equilibrium conditions, Water withdrawal from streams, Method of ground water imaging.

**Text Books:**

1. D.K.Todd, Groundwater Hydrology, John wiley and Sons
2. H.M. Raghunath, Ground Water, Willy Eastern Ltd.

**Reference Books:**

1. C. Fitts, Ground Water Science, Elsevier Publications, U. S. A.
2. P. P. Raj, Geotechnical Engineering, Tata McGraw-Hill

# EARTH RETAINING STRUCTURES

**Module I**

Earth Pressure: Fundamental relationships between the lateral pressures and the strain with a back fill. Rankine and Coulomb theories, Active, passive and pressure at rest; Backfill with broken surface, wall with broken back, concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill. Passive earth pressure in engineering practice. Assumption and conditions, point of application of passive earth pressures

**Module II**

Bulkheads: Definition and assumptions, conditions of end supports and distribution of active earth pressure and bulkheads, bulkheads with free and fixed earth supports, equivalent beam method, Improvements suggested by Rowe, Tschebotarioff's method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates, Consideration of effects of ground water, seepage, surcharge loading together with possibility of shallow and deep sliding failures on retaining structure

**Module III**

Sheet Pile wall: Free earth system, fixed earth system, Dead man ; Tunnel and Conduit: Stress distribution around tunnels, Types of conduits, Load on projecting conduits

**Module IV**

Arching and Open Cuts: Arching in soils, Braced excavations, Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays; Reinforced earth retaining structures- Design of earth embankments and slopes ; Recent advances in Earth retaining structures.

**Text Books:**

1. B. M. Das, Principles of Foundation Engineering, Thomson, Indian Edition, 2003.
2. J. Bowel, Foundation Engineering , Analysis and Design. McGrwHill

**Reference Books:**

1. P. Raj, Geotechnical Engineering, Tata McGraw Hill
2. R F Craig, Soil Mechanics, Chapman and Hall (ELBS)

# EARTHQUAKE GEOTECHNICAL ENGINEERING

**Module I**

Earthquakes: Causes and characteristics (magnitude, intensity, accelarograms), response spectra, attenuation of ground motion. Estimation of seismic hazards (deterministic and probabilistic); Introduction to vibratory motion: Waves in Elastic Medium

**Module II**

Dynamics of Discrete: Systems, Vibration of single and multiple degree of freedom systems. Free and forced vibrations (regular and irregular excitation)

**Module III**

Dynamic properties of soils: Determination of site characteristics, local geology and soil condition, site investigation and soil test, Laboratory and in-situ tests; Site response to earthquake. Seismic Microzonation; Liquefaction of soils: Fundamental concept of liquefaction, assessment of liquefaction susceptibly from SPT and CPT

**Module IV**

Seismic response of soil structure system, seismic bearing capacity of shallow foundation, design of pile foundation in liquefiable ground. Pseudo-static analysis and design of earth retaining structures and soil slopes. Estimation of earthquake-induced deformation.

**Text Books:**

1. S.L. Kramer, Geotechnical Earthquake Engineering, Pentice Hall, international series, Pearson Education (Singapore) Pvt. Ltd., 2004.
2. S.Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd., New Delhi 1999.

**Reference Books:**

1. A. Ansal, Recent Advances in Earthquake Geotechnical Engineering and Microzonation, Springer, 2006.
2. I. Towhata, Geotechnical Earthquake Engineering, Springer, 2008.

# Subsoil Exploration & Soil Testing

**Module-I**

Problems and phases of foundation investigations: Geophysical sounding, drilling and accessible explorations.

**Module-II**

Sample requirements, sampling methods and equipment. Handling, preservation and transportation of samples.

**Module-III**

Sample preparation, laboratory tests, analysis of results and interpretation, importance of in-situ testing.

**Module-IV**

Performing various in-situ tests. Precautions and interpretation, site evaluation and reporting, block vibration test.

**References:**

1. Head, K.H., Manual of Soil Laboratory Testing, Vols. 1 to 3, 1981.

2. Compendium of Indian Standards on Soil Engineering, Parts 1 and II, 1987– 1988.

# DYNAMICS OF SOILS AND FOUNDATIONS

**Module I**

Vibration of elementary systems, Analysis of systems with Single degree and multi-degree of freedom. Natural frequencies of continuous systems

**Module II**

Elastic Constants of soil and their experimental determination. Effect of vibration on soil properties; Bearing capacity of dynamically loaded foundations

**Module III**

Principles of Machine foundation design, Experimental and analytical determination of design parameters

**Module IV**

Design of foundations for turbines, vertical and horizontal reciprocating engines, forge hammers, Effect of machine foundation on adjoining structures, vibration isolation.

**Text Books:**

1. S. Saran, Soil Dynamics and Machine Foundations, Galgotia Publications Private Ltd.1999
2. N. S. V. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wiley New Delhi, 1998

**Reference Books:**

1. B M Das, Principles of Soil Dynamics, Thomsons Engineering, 1992
2. K.G. Bhatia, Foundations For Industrial Machines, D-CAD Publishers, 2008
3. A Major, Vibration Analysis and Design of Foundations for Machines and Turbines: Dynamical Problems in Civil Engineering, AkademiaiKiado Budapest Collets Holding Ltd., 1962

# STRENGTH AND DEFORMATION BEHAVIOUR OF SOIL

**Module I**

Introduction: Physico-Chemical aspects, Failure theories, Yield criteria, Elastic and Plastic analysis of soil, Mohr's diagram. ;

**Module II**

Stresses in Soil: Description of state of stress and strain at a point, stress distribution problems in elastic half pace. Boussinessqu, WestergardMindlin and Kelvin problems. Distribution of contact pressure.

**Module III**

Analysis of Elastic settlement. ; Soil Plasticity.;
Shear Strength of Soils: Experimental determination of shear strength, Types of tests based on drainage conditions and their practical significance, Skempton's and Henkel's pore water pressure coefficients, Stress path, Shear strength of unsaturated soils, Row's stress dilatancy theory.

**Module IV**

Constitutive Models: Constitutive Models in Soil Mechanics: Isotropic Elastic, Anisotropic Plasticity and Viscous Models. Representing Soil Behaviour using these Models. ; Advances in Constitutive models.

**Text Books:**

1. A.P.S. Selvadurai, Plasticity&Geomechanics, Cambridge University Press, 2002
2. W.F. Chen, Limit Analysis & Soil Plasticity, Elsevier Scientific, 1975.

**Reference Books:**

1. C. S. Desai and J. T. Christian, Numerical Methods in Geotechnical Engineering, McGrew Hill, New York.
2. R. F. Scott, Principles of Soil Mechanics, Addison & Wesley

# OPTIMIZATION METHODS AND ITS APPLICATIONS IN CIVIL ENGINEERING

## Module I

Introduction: Need for engineering optimal design, Optimum design formulation: Design variable, objective function and constraints; unconstrained optimization methods Single variable optimization methods: Region elimination method – Golden Section search, Interval halving method; Gradient based method – Newton-Raphson, bisection and secant method.

## Module II

Multi variable optimization methods: Direct search method: Hooke-Jeeves pattern search, simplex reflection search, Powell's conjugate direction search. Gradient Based methods: Cauchy's steeped descent, Newton's method, Levenberg Marquardt's method, Fletcher- Reeve method; constrained optimization methods Kuhn Tucker condition, Penalty function method, Augmented Lagrangian method, sequential unconstrained minimization, cutting plane method;

## Module III

Introduction to Evolutionary algorithms: Need for evolutionary algorithms, Type of evolutionary methods, Introduction to Genetic algorithm (GA), Difference and similarities between GA and traditional methods. Basic operations of GA: reproduction, crossover, mutation and elitism. Binary coded and real coded GA;

## Module IV

Application of Optimization techniques: Water resource planning management, Structural Optimization, Transportation planning and Management, Slope stability and optimal dimensioning of foundations. Multi-objective optimization models.

## References

1. J.S. Arora, Introduction to Optimum Design, Elsevier, 2nd Edition, 2004.
2. K. Deb, Optimization for Engineering. Design: Algorithms & Examples, Prentice Hall India, 2006
3. S.S. Rao, Engineering Optimization: Theory & Practice, New Age International (P) Ltd, 3rd Edition, 1996, Reprint: June, 2008
4. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley, 2003

# COMPOSITE STRUCTURES

**Module I:**

Introduction: definition and characteristics, fibres, matrices, fibre reinforced composites, advantages and limitations, basic concepts and characteristics: isotropy, orthotropic, classification, lamina and laminate, micromechanics and micromechanics, constituent materials and properties.

**Module II:**

Elastic behaviour of unidirectional lamina: specially orthotropic and transversely isotropic material, relation between mathematical and engineering constants, stress strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, transformation of stress-strain relations in terms of engineering constants.

**Module III:**

Elastic behaviour of multidirectional laminates, symmetric and balanced laminates, design considerations, computational procedure for finding engineering elastic properties, stress and failure analysis of multidirectional laminates.

**Module IV:**

Bending of laminated composite plates, thin laminated plate theory, deflection of all edges simply supported rectangular symmetric cross-ply laminate, two opposite edges simply supported.

**Books:**

1. I.M. Daniel & O. Ishai, “Engineering Mechanics of Composite Materials", Oxford Press
2. S.W.Tsai&H.T.Hahn, "Introduction to Composite Materials: Techonomic Pub. Co.INC, USA.
3. P.K.Sinha,"A short term course on Composite Materials and Structures"-1996

# HYDRO POWER ENGINEERING

**Module I:**

Instruction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

**Module II:**

Classification of Hydel Plants: Run off river plants, general arrangement of run off river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three unit arrangement, reversible pump turbines, problems of operation, power house, efficiency of P-S plants.

**Module III:**

Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. Intakes: Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels. Turbines: Introduction, types of turbines, hydraulic features, turbine size, constructional features of turbines, layout arrangements, hydraulic of turbines, basic flow equations, draft tubes, cavitations in turbines, governing of turbines, characteristics of turbines, illustrative examples.

**Module IV:**

Power House Planning: Surface power stations: power house structure, power house dimensions, lighting and ventilation, variations in design of power house. Underground power station: Location of U.G. power station, Types of U.G. power stations, advantages of U.G. power house, components of U.G. power house, types of layout, limitations of U.G. power house structural design of power house. Tidal power: Basic principle, location of tidal power plant, difficulties in tidal power generation, components of tidal power plants, modes of generation, single basin arrangement, double basin system.

**References:**

1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
2. Irrigation and water resources Engg. By G.L. Asawa, New Age international Publishers.
3. Irrigation and water power Engineering by B.C. Punamia, Pande B.B. Lal (Laxmi Publications Private Limited)

# NON-CONVENTIONAL ENERGY

**Module I**

Introduction various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. 3 Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

**Module II**

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**Module III**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. 4 Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. 2 Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

**Module IV**

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. 2 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.
Bio-mass: Availability of bio-mass and its conversion theory. 2 Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

**References Books:**

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International. 5.
C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.

# ADVANCED NUMERICAL METHODS

**Module I:**

Introduction to digital computers & Programming - an overview; Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

**Module II:**

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods. Matrices – Linear equations, Eigenvalues and Eigenvectors - nonlinear equations,

**Module III:**

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

**Module IV:**

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

**Referrences**

1. Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg.Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
3. Gerld C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.
5. Johnson R.A " Probability and Statistics for Mngineers.
6. Rajeshwaran S, "Numerical Methods in Science & Engineering (A Practical Approach)",Willey Publication.

# Green Building Concepts

**Module I**

Environmental implications of buildings energy, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transporation Energy for Building Materials; Maintenance Energy for Buildings.

**Module II**

Implications of Building Technologies Embodied Energy of Buildings: Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

**Module III**

Comforts in Building: Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

**Module IV**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings. Unit V Green Composites for buildings: Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**TEXT BOOKS**

[1] K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
[2] Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
[3] Green My Home!: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint, by Dennis C. Brewer, ISBN:9781427798411, Publisher: Kaplan Publishing, Publication Date: October 2008.
[4] B. Givoni, Man, Climate and Architecture Elsevier, 1969.
[5] T. A. Markus and E. N. Morris Buildings Climate and Energy. Pitman, London, 1980. Arvind Kishan et al (Ed)
[6] Climate Responsive Architecture. TataMcGraw Hill, 2001.
[7] Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
[8] O. H. Koenigs Berger, T. G. Ingersoll, Alan Mayhew and S. V. Szokolay. Manual of Tropical Housing and Building. Orient Long man, 1975.

**REFERENCE BOOKS**

[1] Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
[2] Michael F. Ashby Materials and the Environment, Elsevier, 2009.
[3] Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
[4] Mili M. Ajumdar (Ed) Energy Efficient Building in India. Teri and Mnes, 2001/2002.
[5] T. N. Seshadri et al Climatological and Solar Data for India. CBRI and SaritaPrakashan, 1968. 34
[6] Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

[7] The New Solar Electric Home: The Photovoltaics How-To Handbook, by Joel Davidson, ISBN: 9780937948095, Publisher: Aatec Publications, Publication Date: July 1987.

## BRANCH-CIVIL ENGINEERING

### *Specialization: Structural Engineering/ Structural and Foundation Engineering*

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Theory | | | | Practical | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Advanced Reinforced Concrete Design | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Matrix Methods of Analysis of Structure | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Structural Dynamics 2.Advanced Steel Structure 3. Bridge Engineering 4.Earthquake Resistance Design of Structure | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1.Advance Construction Materials 2. Offshore Engineering 3. Tall Structures 4.Optimization Methods & its Application in Civil Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

# ADVANCED REINFORCED CONCRETE DESIGN

**Module I:**
Limit state design concepts in flexure, shear, torsion and combined stresses. Slender column

**Module II:**
Safety and serviceability, control of cracks and deflections.

**Module III:**
Yield line theory analysis of slabs, work and equilibrium methods.

**Module IV:**
Introduction to limit design of beams and frames. General principles and philosophies of design with special references to the codal provisions. Serviceability and stability requirements.

**Books:**

1) Park & Paunlay,"Reinforced Concrete Structures".
2) Ramakrishna & Arthur,"Ultimate strength design for structural concrete".
3) B.I.S. Codes

# MATRIX METHODS OF ANALYSIS OF STRUCTURES

**Module I:**
Introduction, equilibrium, static and kinematic indeterminacy, kinematics, virtual work, concepts of stiffness and flexibility, analysis by displacement and force methods.

**Module II:**
Application of flexibility method to beams and plane trusses.

**Module III:**
Application of stiffness method to beams, plane frames and plane trusses.

**Module IV:**
Application of stiffness method to space truss, space frames and grids, basic concepts associated with computer implementation of stiffness method.

**Books:**

**1.** H.C.Martin," Introduction to Matrix Methods of Structural Analysis.
**2.** M.B.Kanchi, "Matrix Methods of Structural Analysis", New Age International Publishers, New Delhi Kardestuncer ,
**3.** "Elementary Matrix Analysis of Structures" Gere & Weaver,"Matrix Structural Analysis'

# STRUCTURAL DYNAMICS

**Module I:**

Oscillatory motion; harmonic motion, periodic motion, vibration terminology,Free vibration; equations of motion-natural frequency, energy method, principle of virtual work, viscously damped free vibration, Coulomb damping, Harmonically excited vibration; forced harmonic vibration, energy dissipated by damping, equivalent viscous damping, structural damping, vibration measuring instruments

**Module II:**

Transient vibration; impulse excitation, arbitrary excitation, Laplace transform formulation, response spectrum, Introduction to multi degree of freedom systems; normal mode vibration, forced harmonic vibration, vibration absorber, vibration damper.

**Module III:**

Properties of vibrating systems, flexibility matrix, stiffness matrix, stiffness to beam elements, eigen values and eigen vectors, modal matrix, modal damping in forced vibration, normal mode summation, normal mode vibration of continuous beams, vibrating string, longitudinal vibration of rods, torsional vibration of rods, Euler equation for beam, effect of rotary inertia and shear deformation.

**Module IV:**

Random vibrations, random phenomena, time averaging and expected value, frequency response function.

**Books:**

W.T.Thomson, "Theory of Vibration with Applications" (2) R.W. Clough & J.Penzien, " Dynamics of Structures", McGraw Hill

## ADVANCED STEEL STRUCTURE

**Module I:**

Properties of steel: mechanical properties, hysteresis, ductility; Hot-Rolled Sections: compactness and non-compactness, slenderness, residual stresses; Design of steel structures:

**Module II:**

Inelastic bending – curvature, plastic moments, design criteria - stability , strength, drift; Stability criteria: stability of beams - local buckling of compression flange & web, lateral-torsional buckling,

**Module III:**

Stability of columns - slenderness ratio of columns, local buckling of flanges and web, bracing of column about weak axis, method of design - allowable stress design, plastic design, load and resistance factor design; Strength Criteria: beams – flexure, shear, torsion, columns - moment magnification factor, effective length, P-M interaction, bi-axial bending, joint panel zones; Drift criteria: P-Δ effect,

**Module IV:**

Deformation-based design; Connections: types – welded, bolted, location - beam-column, column-foundation, splices.

# TALL STRUCTURES

**Module I**:

Structural systems and concepts. Matrix and approximate methods, analysis of tall building frames, lateral load analysis, multi bay frames, gravity loads, settlement of foundation.

**Module II:**

Foundation-superstructure interaction. Earthquake effects and design for ductility. Analysis of shear walls - plane shear walls, infilled frames, coupled frames, frames with shear walls.

**Module III**:

Principle of three dimensional analysis of tall buildings; Perforated cores, pure torsion in thin tubes, bending and warping of perforated cores.

**Module IV:**

Analysis of floor system in tall buildings, Vierendal girders, diagrid floors, elastic stability of frames and shear walls. Analysis of thermal stresses.

**Reference Books:**

1. Tall buildings - B. S. Taranath:
2. Handbook of Concrete Structures - Mark Fintel
3. Tall buildings - Coull and Smith
4. Design of Multi-storeyed structures - U. H. Variani
5. Tall Chimneys: Design & Construction - S. N. Manohar
6. Transmission Line Structures - Santhakumar & Murthy
7. IS:6533 (Part 2) –Code of Practice for Design and Construction of Steel Chimney
8. IS:4998 (Part 1)- Criteria for Design of Reinforced Concrete Chimneys

# EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

**Module I**:

Characteristics of earthquakes; Earthquake response of structures; Seismology, seismic risk and hazard, Soil dynamics and seismic inputs to structures, Characterization of ground motion; lateral load calculation, base shear

**Module II:**

Earthquake intensity and magnitude; Recording instruments and base line correction; Predominant period and amplification through soil; Response spectrum, analysis, Spectral analysis,

**Module III**:

Idealization of structural systems for low, medium and high rise buildings; Nonlinear and push over analysis, Dynamic soil-structure interaction. Earthquake design philosophy,

**Module IV:**

Concept of earthquake resistant design; Code provisions of design of buildings; Reinforcement detailing for members and joints, retrofitting and strengthening of structures, concept of base isolation design and structural control.

**Text Book:**

1. Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992
2. Earthquake Resistant Design: Shrikhandee & Agarwal-PHI Publ
3. Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.', Prentice Hall, 1971.
4. David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London, 1988.
5. Wiegel R.L., 'Earthquake Engg.', Prentice Hall, 1970.
6. Blume J.A., Newmark N.M., Corning L.H., 'Design of Multi-storied Buildings for Earthquake ground motions', Portland Cement Association, Chicago, 1961.
7. Proc. World Conferences on Earthquake Engg., 1956-1992.
8. I.S. Codes No. 1893, 4326, 13920 etc.

# ADVANCED CONSTRUCTION MATERIALS

**Module I**:

Fresh concrete and its rheology. Mechanical, deformational behavior and microstructure of hardened concrete. Creep and shrinkage. Testing of concrete. mix design and properties of concrete; High strength concrete; High density and lightweight concretes; admixtures

**Module II:**

Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concreting under extreme weather conditions, High strength concrete. Changes in concrete with time, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Ferro-cement, material and properties.

**Module III:**

Foams and light weight materials, fibrereinforced concrete. Types of fibres, workability, mechanical and physical properties of fibre reinforced concrete. Polymers in Civil Engineering, Polymers, fibres and composites,

**Module IV:**

Fibre reinforced plastic in sandwich panels, modeling. Architectural use and aesthetics of composties. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building, Polymer concrete composites.

**Books:**

1. Neville A.M., 'Properties of concrete', 3rd ed., 1985, ELBS Lea F.M.,
2. 'Chemistry of cement and concrete', 3rd ed., 1970, Edward Arnold Proceedings of recent seminars etc. and journals.

# OFFSHORE STRUCTURES

**Module I:**

Design of offshore platforms : Introduction, fixed and floating platforms. case studies and general features-elements of hydrodynamics and wave theory-fluid structure interaction, Steel, concrete and hybrid platforms.

**Module II:**

Design criteria. Environmental loading. Wind, wave and current loads after installation. Stability during towing. Foundations : Site investigations. Piled foundation. Foundations for gravity structures.

**Module III**:

Behaviour under dynamic loading. Static and dynamic analysis of platforms and components.

**Module IV:**

Dynamic response in deterministic and in deterministic environment, codes of practice, analysis of fixed platform and semisubmersible related topics.

**References:**

1. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.

2. --American Petroleum Institute, API RP-2A, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms.

3. McClelland, B & Reifel, M. D., Planning & Design of fixed Offshore Platforms, Van Nostrand, 1986. 4. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981

5. Reddy, D. V and Arockiasamy, M., Offshore Structures Vol. 1& 2, Kreiger Publ. Co.1991.

6. Morgan, N., Marine Technology Reference Book, Butterworths, 1990.

# BRIDGE ENGINEERING

**Module I**:

Introduction and selection of type of bridges, longitudinal arrangement and economical span, bridge components, Design preliminaries: Layout, types of loads including wind and seismic loads, standard specifications for road bridges, substructures, superstructures, IRC provisions on loads and stresses, specification for single/double multi lane railway and road bridges, Abutments, piers and their foundations .

**Module II**:

Design of reinforced concrete slab culvert, box culvert bridge.

**Module III**:

Tee beam and slab bridge deck, design of prestressed concrete bridge.

**Module IV**:

Design of balanced cantilever bridge, design of continuous bridge, Introduction to long span bridges.

**Books:**

1) N.K.Raju, " Design of bridges", Oxford & IBH Publishing Co. pvt. ltd. D.J.Victor, " Essentials of bridge engineering", Oxford &IBH Publishing Co. pvt. ltd. Indian Road Congress Codes No.5,6,18,21,24, Jamnagar House, Shah Jahan Road, New Delhi.

# STRUCTURAL OPTIMISATION

**Module I:**

Formulation of different types of structural optimization problems; Optimality criteria based structural optimizations;

**Module II:**

Computation of derivatives of response quantities w.r.t. design variables; Classical optimization;

**Module III:**

Lagrange multiplier technique and Kuhn-Tucker conditions;

**Module IV:**

Solution of NLP by direct methods and by series of unconstrained optimization problems and by series of linear programming problems.

**Books:**

1. S.S. Rao, Optimization, Theory and Applications, 2nd Edition, Wiley Eastern Ltd., New Delhi, 1991.
2. J.S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company, New York, 1989.
3. A.J. Morris (Editor), Foundations of Structural Optimization - A Unified Approach; John Wiley and Sons, Chichester, 1982.

# COMPOSITE STRUCTURES

**Module I:**

Introduction: definition and characteristics, fibres, matrices, fibre reinforced composites, advantages and limitations, basic concepts and characteristics: isotropy, orthotropic, classification, lamina and laminate, micromechanics and micromechanics, constituent materials and properties.

**Module II:**

Elastic behaviour of unidirectional lamina: specially orthotropic and transversely isotropic material, relation between mathematical and engineering constants, stress strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, transformation of stress-strain relations in terms of engineering constants.

**Module III:**

Elastic behaviour of multidirectional laminates, symmetric and balanced laminates, design considerations, computational procedure for finding engineering elastic properties, stress and failure analysis of multidirectional laminates.

**Module IV:**

Bending of laminated composite plates, thin laminated plate theory, deflection of all edges simply supported rectangular symmetric cross-ply laminate, two opposite edges simply supported.

**Books:**

1. I.M. Daniel & O. Ishai, “Engineering Mechanics of Composite Materials", Oxford Press
2. S.W.Tsai & H.T.Hahn, "Introduction to Composite Materials: Techonomic Pub. Co.INC, USA.
3. P.K.Sinha,"A short term course on Composite Materials and Structures"-1996

# HYDRO POWER ENGINEERING

**Module I:**

Instruction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

**Module II:**

Classification of Hydel Plants: Run off river plants, general arrangement of run off river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three unit arrangement, reversible pump turbines, problems of operation, power house, efficiency of P-S plants.

**Module III:**

Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. Intakes: Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels. Turbines: Introduction, types of turbines, hydraulic features, turbine size, constructional features of turbines, layout arrangements, hydraulic of turbines, basic flow equations, draft tubes, cavitations in turbines, governing of turbines, characteristics of turbines, illustrative examples.

**Module IV:**

Power House Planning: Surface power stations: power house structure, power house dimensions, lighting and ventilation, variations in design of power house. Underground power station: Location of U.G. power station, Types of U.G. power stations, advantages of U.G. power house, components of U.G. power house, types of layout, limitations of U.G. power house structural design of power house. Tidal power: Basic principle, location of tidal power plant, difficulties in tidal power generation, components of tidal power plants, modes of generation, single basin arrangement, double basin system.

**References:**

1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
2. Irrigation and water resources Engg. By G.L. Asawa, New Age international Publishers.
3. Irrigation and water power Engineering by B.C. Punamia, Pande B.B. Lal (Laxmi Publications Private Limited)

# NON-CONVENTIONAL ENERGY

**Module I**

Introduction various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. 3 Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

**Module II**

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**Module III**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. 4 Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. 2 Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

**Module IV**

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. 2 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.
Bio-mass: Availability of bio-mass and its conversion theory. 2 Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

**References Books:**

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International. 5.
C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.

# ADVANCED NUMERICAL METHODS

**Module I:**

Introduction to digital computers & Programming - an overview; Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

**Module II:**

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods. Matrices – Linear equations, Eigenvalues and Eigenvectors - nonlinear equations,

**Module III:**

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

**Module IV:**

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

**Referrences**

1. Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg.Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
3. Gerld C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.
5. Johnson R.A " Probability and Statistics for Mngineers.
6. Rajeshwaran S, "Numerical Methods in Science & Engineering (A Practical Approach)",Willey Publication.

# Green Building Concepts

**Module I**

Environmental implications of buildings energy, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transporation Energy for Building Materials; Maintenance Energy for Buildings.

**Module II**

Implications of Building Technologies Embodied Energy of Buildings: Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

**Module III**

Comforts in Building: Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

**Module IV**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings. Unit V Green Composites for buildings: Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**TEXT BOOKS**

[1] K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
[2] Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
[3] Green My Home!: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint, by Dennis C. Brewer, ISBN:9781427798411, Publisher: Kaplan Publishing, Publication Date: October 2008.
[4] B. Givoni, Man, Climate and Architecture Elsevier, 1969.
[5] T. A. Markus and E. N. Morris Buildings Climate and Energy. Pitman, London, 1980. Arvind Kishan et al (Ed)
[6] Climate Responsive Architecture. TataMcGraw Hill, 2001.
[7] Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
[8] O. H. Koenigs Berger, T. G. Ingersoll, Alan Mayhew and S. V. Szokolay. Manual of Tropical Housing and Building. Orient Long man, 1975.

**REFERENCE BOOKS**

[1] Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
[2] Michael F. Ashby Materials and the Environment, Elsevier, 2009.
[3] Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
[4] Mili M. Ajumdar (Ed) Energy Efficient Building in India. Teri and Mnes, 2001/2002.
[5] T. N. Seshadri et al Climatological and Solar Data for India. CBRI and Sarita Prakashan, 1968. 34
[6] Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

[7] The New Solar Electric Home: The Photovoltaics How-To Handbook, by Joel Davidson, ISBN: 9780937948095, Publisher: Aatec Publications, Publication Date: July 1987.

## BRANCH-CIVIL ENGINEERING

***Specialization: Transportation Engineering***

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory** | | | | | **Practical** | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Geometric Design of Highways | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Transportation Systems Planning | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Advanced Railway Engineering 2.Planing & Design of Airport 3. Bridge Engineering 4.Ground Improvement Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II(Departmental related)*** 1.Advance Construction Materials 2. Mass Transit Systems 3. Traffic Engineering & Traffic Flow Theory 4.Transportation & Environment | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

# GEOMETRIC DESIGN OF HIGHWAYS

Highway capacities and speeds on rural and urban roads, Special aspects of horizontal and vertical alignments, Interrelationships between geometric elements in rural and urban roads, Variations in geometric standards between plains and hilly regions, Special curves, Design aspects of intersections and grade separations, Traffic rotaries, Flyovers and cloverleaf junctions.

**Essential Reading:**

1. C. S. Papacostas, P. D. Prevedouros, *Transportation Engineering and Planning*, PHI Publication, 3rd edition , 2002

2. L.R. Kadiyalli, *Traffic Engineering and Transport Planning*, Khanna Publishers, 7th edition, 2008.

**Supplementary Reading:**

1. P.H. Wright, K.K. Dixon, *Highway Engineering*, John Willey, 2004

2. C.J. Khisty and B. Lall, *Transportation Engineering*, PHI Publication, 3 ed., 2006 Relevant IRC and other Codes and specifications

3. J.G. Schoon, *Geometric Design Projects for Highways: An Introduction, American Society of Civil Engineers* (ASCE Press), 2nd Edition, 2002

# TRANSPORTATION SYSTEMS PLANNING

Brief Description of urban and regional transportation systems, Definition of a system ; System analysis: scope and limitations, Transportation planning based upon system analysis, Survey and analysis of existing conditions, Models for trip generation, trip distribution, traffic assignment and modal split ; Analysis of future conditions, Plan synthesis and evaluation.

**Essential Reading:**

1. L.R. Kadiyalli, Traffic Engineering and Transport Planning, Khanna Publishers, 7th edition, 2008

2. C. S. Papacostas, P. D. Prevedouros, Transportation Engineering and Planning, PHI Publication, 3rd edition , 2002.

**Supplementary Reading:**

1. M.J. Bruton, Introduction to Transportation Planning (Built Environment), Routledge, 1992.

2. J.D. Fricker and R. K. Whitford, Fundamentals of Transportation Engineering: A Multimodal System Approach, Pearson Education, PH, 2005

3. Ortuzar & Willumsen, Modeling Transport, John Wiley, 1990

# ADVANCED RAILWAY ENGINEERING

Track and track stresses, Train resistances and hauling power of locomotives ; Railway track components: Important features, Railway curves, Superelevation, Gradients and grade compensation, Points and crossing and their design approaches. ; Construction and maintenance of railway track, Control of train movements; Signals and interlocking, Modernisation of railways and future trends; Track standards and track rehabilitation.

**Essential Reading:**

1. J.S. Mundrey, Railway Track Engineering, Tata McGraw Hill Co. Ltd., 3rd Edition, 2000.

2. M.M. Agarwal, Railway Track Engineering, Standard Publishers, 1st Ed. 2005.

**Supplementary Reading:**

1. S. Chandra and Aqarwal, Railway Engineering, Oxford University Press, 1st Ed. Feb 2008.

2. A.D. Kerr, Fundamentals of Railway Track Engineering, Simmons Boardman Pub Co (December 30, 2003)

# PLANNING AND DESIGN OF AIRPORTS

Classification of airports- ICAO standards ; Planning for airport- Airport components- Zoning laws ; Runways- orientation and geometric design- Runway patterns ; Taxiways- alignment- geometry and turning radius- exit taxiways ; Aprons- planning and design ; Design principles of critical, semi-critical, non-critical airport pavements- FAA and PCA methods ; Airport hangars- their planning and design criteria ; Airport landscaping, grading and drainage- general aspects ; Airport terminal and amenities ; Airport lighting and marking.

**Essential Reading:**

1. N.J. Ashford, P.H. Wright, Airport Engineering, 3rd Edition, 1992, John Wiley

2. R.M. Horonjeff, F.X. Mc Kelvey, W.J Sproule, Seth Young, Planning and Design of Airports, TMH International Publishers, Fifth Edition, 2009

**Supplementary Reading:**

1. Khanna, Arora and Jain, Planning and Design of Airports, Nemchand Bros., 2001

2. Wells, Alexander; Young, Seth, Airport Planning & Management, McGraw Hill,5th Edition, July,2009

3. De N. Richard, & Odoni, Airport Systems: Planning, Design, and Management, McGraw Hill Amedeo, 1st Edition, 2004.

# BRIDGE ENGINEERING

Introduction, historical review, engineering and aesthetic requirements in bridge design. Introduction to bridge codes. Economic evaluation of a bridge project. Site investigation and planning;. Scour - factors affecting and evaluation. Bridge foundations - open, pile, well and caisson. Piers, abutments and approach structures; Superstructure - analysis and design of right, skew and curved slabs. Girder bridges - types, load distribution, design. Orthotropic plate analysis of bridge decks. Introduction to long span bridges - cantilever, arch, cable stayed and suspension bridges. Methods of construction of R.C Bridges, Prestressed concrete bridges and steel bridges Fabrication, Lounching & creation. Design and construction of construction joints (use of relevant codes of practice are permitted in the examination).

**Essential Reading:**

1. V. K. Raina, Concrete Bridges Practice – Analysis, Design and Economics, Shroff Publications, New Delhi 2nd Ed. 2005.

2. Vazirani, Ratwani and Aswani, Design of Concrete Bridges, Khanna Publishers , 2nd Ed. 2008.

**Supplementary Reading:**

1. IRC codes for Road bridges- IRS Sec –I , II, III

2. IRS Codes of Practice for Railway bridges.

3. B. M. Das, Principles of Foundation Engineering, Thomson, Indian Edition, 2003.

# Ground Improvement Engineering

**Module I**

Introduction, typical situations where ground improvement becomes necessary, historical review of methods adopted in practice, current status and the scope in the Indian context.

**Module II**

Methods of ground improvement, mechanical compaction, dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, dynamic consolidation, design aspects of stone columns, use of admixtures, injection of grouts, design guidelines and quality control, design examples on preloading with sand drains, road designs with geo-synthetics.

**Module III**

Reinforced earth, basic mechanism, constituent materials and their selection; engineering applications – shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth.

**Module IV**

Geotextiles, selection and engineering applications, design examples, stabilisation/improvement of ground using geomembranes, geocells, geonets, geosynthetic walls.
Soil nailing, construction of underground structures, landslide controls, deep vertical cuts, contiguous piles.
Problematic soils, use of ply soils, improvement of saline soils, improvement of black cotton soils.

**References:**

1) Moseley, M. P. and Kirsch K.,"Ground Improvement", Spon press.
2) Mittal, Satyendra, "Ground Improvement Engineering", Vikas publishing house
3) Koerner, R.M., "Designing with Geosynthetics"' Prentice hall.
4) Saran, S., "Reinforced Soil and Its Engineering Applications", I.K. international.
5) Rao, G.V., Geosynthetics – An Introduction, Sai Master geoenvironmental services.
6) Jones, CJFP, "Earth Reinforcement and soil structure", Thomas Telford.
7) Shukla, S.K., Yin, Jian-Hua, "Fundamentals of Geosynthetic Engineering", Taylor & Francis.

# ADVANCED CONSTRUCTION MATERIALS

**Module I**:

Fresh concrete and its rheology. Mechanical, deformational behavior and microstructure of hardened concrete. Creep and shrinkage. Testing of concrete. mix design and properties of concrete; High strength concrete; High density and lightweight concretes; admixtures

**Module II:**

Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concreting under extreme weather conditions, High strength concrete. Changes in concrete with time, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Ferro-cement, material and properties.

**Module III:**

Foams and light weight materials, fibrereinforced concrete. Types of fibres, workability, mechanical and physical properties of fibre reinforced concrete. Polymers in Civil Engineering, Polymers, fibres and composites,

**Module IV:**

Fibre reinforced plastic in sandwich panels, modeling. Architectural use and aesthetics of composties. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building, Polymer concrete composites.

**Books:**

1. Neville A.M., 'Properties of concrete', 3rd ed., 1985, ELBS Lea F.M.,
2. 'Chemistry of cement and concrete', 3rd ed., 1970, Edward Arnold Proceedings of recent seminars etc. and journals.

# MASS TRANSIT SYSTEMS

Mass Transit concepts- Trip interchanges and assignments ; Urban transportation problems,Modes of mass transit- their planning, construction and operation, Case studies of existing mass transit systems ; Technical and economic evaluation of mass transit projects

**Essential Readings:**

1. C. S. Papacostas, P. D. Prevedouros, Transportation Engineering and Planning, PHI Publication, 3rd edition, 2002

2. S. Grava, Urban Transportation Systems, Mc. Graw Hill Professional, 1st Ed. 2002

**Supplementary Readings:**

1. J.D. Fricker, & R.K. Whitford, Fundamentals of Transportation Engineering, Pearson, PH, 2004

2. V.R. Vuchic, Urban Transit Systems and Technology, John Wiley & Sons, February 2007

3. C.A. O'Flaherty, Transport Planning and Traffic Engineering, Arnold, 1997

4. J. E. Anderson, Transit Systems Theory, Lexinton Books, USA

# TRAFFIC ENGINEERING AND TRAFFIC FLOW THEORY

Traffic surveys: Speed, volume, delay, origin and destination, parking ; Traffic controls: Traffic signs, signals, road marking and other traffic control aids ; Traffic safety: Accidents, causes and prevention ; Traffic flow theory: Light hill and Witham's theory, the queuing theory and its application to traffic engineering problems, car flow theory ; Simulations of traffic: scanning technique

**Essential Reading:**

1. L.R. Kadiyalli, Traffic Engineering and Transport Planning, Khanna Publishers, 7th edition, 2008.

2. C.A.O'Flaherty, Transport Planning and Traffic Engineering, Arnold, 1997

**Supplementary Reading:**

1. R. P. Roess, E. S. Prassas, & W.R. Mc Shane, Traffic Engineering, Prentice Hall, 3rd Edition, 2004

2. May, Traffic Flow Fundamentals, Prentice Hall, 1989

3. F. L. Mannering, Principles of Highway Engineering and Traffic Analysis, 4th Edition, 2008, John Wiley.

# TRANSPORTATION AND ENVIRONMENT

The Road Environment: human factors in road user behavior, vehicle characteristics, driver, road and environment. Environmental Factors: impacts and mitigation measures of air quality, noise, severance, visual intrusion, impact on water quality, use of limited resources, impact on flora & fauna, vibration, dust ; Transport related pollution; Technology Vision-2020; Urban and non urban traffic noise sources, Noise pollution; Energy related aspects of different transport technologies. Traffic calming, Measures, Road transport related air pollution, sources of air pollution, effects of weather conditions, Vehicular emission parameters, pollution standards, measurement and analysis of vehicular emission; Imitative measures; EIA requirements of Highways projects, Procedure; MOEF World Bank/EC/UK guidelines ; EIA practices in India.

**Essential Reading:**

1. K. Wark, C.F. Warner, & W.T. Davis, Air Pollution: Its Origin and Control, Prentice Hall. 3rd Ed. 1997.

2. R.W. Boubel, Fundamentals of Air Pollution, Academic Press, 4th Ed. 2007.

**Supplementary Reading:**

1. D. Vallero, Fundamentals of Air Pollution, Academic Press, 4th Ed. 2007.

2. L. Canter, Environmental Impact Assessment, McGraw-Hill International, 2nd Ed. 1995.

# COMPOSITE STRUCTURES

**Module I:**

Introduction: definition and characteristics, fibres, matrices, fibre reinforced composites, advantages and limitations, basic concepts and characteristics: isotropy, orthotropic, classification, lamina and laminate, micromechanics and micromechanics, constituent materials and properties.

**Module II:**

Elastic behaviour of unidirectional lamina: specially orthotropic and transversely isotropic material, relation between mathematical and engineering constants, stress strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, transformation of stress-strain relations in terms of engineering constants.

**Module III:**

Elastic behaviour of multidirectional laminates, symmetric and balanced laminates, design considerations, computational procedure for finding engineering elastic properties, stress and failure analysis of multidirectional laminates.

**Module IV:**

Bending of laminated composite plates, thin laminated plate theory, deflection of all edges simply supported rectangular symmetric cross-ply laminate, two opposite edges simply supported.

**Books:**

1. I.M. Daniel & O. Ishai, “Engineering Mechanics of Composite Materials", Oxford Press
2. S.W.Tsai & H.T.Hahn, "Introduction to Composite Materials: Techonomic Pub. Co.INC, USA.
3. P.K.Sinha,"A short term course on Composite Materials and Structures"-1996

# HYDRO POWER ENGINEERING

**Module I:**

Instruction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

**Module II:**

Classification of Hydel Plants: Run off river plants, general arrangement of run off river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three unit arrangement, reversible pump turbines, problems of operation, power house, efficiency of P-S plants.

**Module III:**

Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. Intakes: Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels. Turbines: Introduction, types of turbines, hydraulic features, turbine size, constructional features of turbines, layout arrangements, hydraulic of turbines, basic flow equations, draft tubes, cavitations in turbines, governing of turbines, characteristics of turbines, illustrative examples.

**Module IV:**

Power House Planning: Surface power stations: power house structure, power house dimensions, lighting and ventilation, variations in design of power house. Underground power station: Location of U.G. power station, Types of U.G. power stations, advantages of U.G. power house, components of U.G. power house, types of layout, limitations of U.G. power house structural design of power house. Tidal power: Basic principle, location of tidal power plant, difficulties in tidal power generation, components of tidal power plants, modes of generation, single basin arrangement, double basin system.

**References:**

1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
2. Irrigation and water resources Engg. By G.L. Asawa, New Age international Publishers.
3. Irrigation and water power Engineering by B.C. Punamia, Pande B.B. Lal (Laxmi Publications Private Limited)

# NON-CONVENTIONAL ENERGY

**Module I**

Introduction various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. 3 Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

**Module II**

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**Module III**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. 4 Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. 2 Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

**Module IV**

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. 2 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems. Bio-mass: Availability of bio-mass and its conversion theory. 2 Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

**References Books:**

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.

2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.

3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.

4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International. 5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.

# ADVANCED NUMERICAL METHODS

**Module I:**

Introduction to digital computers & Programming - an overview; Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

**Module II:**

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods. Matrices – Linear equations, Eigenvalues and Eigenvectors - nonlinear equations,

**Module III:**

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

**Module IV:**

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

**Referrences**

1. Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg.Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
3. Gerld C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.
5. Johnson R.A " Probability and Statistics for Mngineers.
6.Rajeshwaran S, "Numerical Methods in Science & Engineering (A Practical Approach)",Willey Publication.

# GREEN BUILDING CONCEPTS

**Module I**

Environmental implications of buildings energy, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transporation Energy for Building Materials; Maintenance Energy for Buildings.

**Module II**

Implications of Building Technologies Embodied Energy of Buildings: Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

**Module III**

Comforts in Building: Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

**Module IV**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings. Unit V Green Composites for buildings: Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**TEXT BOOKS**

[1] K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.

[2] Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.

[3] Green My Home!: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint, by Dennis C. Brewer, ISBN:9781427798411, Publisher: Kaplan Publishing, Publication Date: October 2008.

[4] B. Givoni, Man, Climate and Architecture Elsevier, 1969.

[5] T. A. Markus and E. N. Morris Buildings Climate and Energy. Pitman, London, 1980. Arvind Kishan et al (Ed)

[6] Climate Responsive Architecture. TataMcGraw Hill, 2001.

[7] Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

[8] O. H. Koenigs Berger, T. G. Ingersoll, Alan Mayhew and S. V. Szokolay. Manual of Tropical Housing and Building. Orient Long man, 1975.

**REFERENCE BOOKS**

[1] Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.

[2] Michael F. Ashby Materials and the Environment, Elsevier, 2009.

[3] Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.

[4] Mili M. Ajumdar (Ed) Energy Efficient Building in India. Teri and Mnes, 2001/2002.

[5] T. N. Seshadri et al Climatological and Solar Data for India. CBRI and Sarita Prakashan, 1968. 34

[6] Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

[7] The New Solar Electric Home: The Photovoltaics How-To Handbook, by Joel Davidson, ISBN: 9780937948095, Publisher: Aatec Publications, Publication Date: July 1987.

## BRANCH-CIVIL ENGINEERING

***Specialization:** Water Resource Engineering & Management/ Water Resource Engineering*

| Second Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Theory | | | | Practical | | |
| **Course Name** | **Hours/ Week L/T** | **Credit Theory** | **University Marks** | **Internal Evaluation** | **Hours/ Week L/T** | **Credit Practical** | **Marks** |
| ***Specialization Core-1*** Ground Water Hydrology | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Specialization Core-2*** Free Surface Flow | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective I(Specialization related)*** 1.Advanced Fluid Mechanics 2. Applied Hydrology 3.Fluvial Hydraulics 4. Ground Improvement Engineering | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective II (Departmental related)*** 1. Design of Irrigation Structure 2. GIS & Remote Sensing 3. Irrigation & Drainage 4.Water Resources System & Management | 4-0 | 4 | 100 | 50 | - | - | - |
| ***Elective III(from any department)*** 1. Composite Structure 2. Hydropower Engineering 3.Non-conventional Energy 4. Advanced Numerical Method 5.Green Building Concepts | 4-0 | 4 | 100 | 50 | - | - | - |
| **Lab-2 (Specialization lab to be decided by the department)** | | | | | 4 | 4 | 150 |
| **Seminar/Project** | | | | | 4 | 4 | 150 |
| Total | | | | | | | |
| Total Marks: 1050 | | | | | | | |
| Total Credits: 28 | | | | | | | |

# GROUND WATER HYDROLOGY

**Module I**

Well Hydraulics: Aquifers and Aquifer Parameters, Darcy's law, Hydraulic Conductivity and its Characteristics, Dupuit Equation, Groundwater Flow Direction Steady Groundwater Flow, Groundwater Flow Equation, Estimation of Aquifer Parameters from Pumping Test Data, Graphical Techniques and their Limitations, Groundwater Well Losses, Interference among Wells, Potential Flow, Image well theory and its Application in Groundwater Flow.

**Module II**

Water Well Design and Well Drilling: Well Screen, Development and Completion of Well, Rotary Drilling and Rotary Percussion Drilling, maintenance of Wells.

**Module III**

Hydrogeology: Porosity and Permeability of Rocks, Groundwater in Igneous, Metamorphic, Sedimentary Rocks and Non Industrated Sediments, Hydrogeological Regions of India. Surface and Subsurface Geophysical methods for Groundwater Explorations.

**Module IV**

Groundwater Management: Conjunctive Use, Alternative Basin Yields, Artificial Recharge of Groundwater, Groundwater Quality. Groundwater Modelling: Groundwater Flow, mathematical, Analog and Digital modelling, Regional Groundwater Modelling.

**References:**

1. Walton, W.C. "Groundwater Resources Evaluation", McGraw Hill Inc, n York
2. Todd, D.K. "Groundwater Hydrology", John Wiley & Sons, Singapore
3. Johnson, E.E."Groundwater", E. Johnson Inc. Washington.
4. Raghunath, H.M. "Groundwater", Wiley Eastern Ltd, N Delhi
5. Sharma, H.D. and Chawla, A.S. "Manual on Groundwater and Tube Wells", Technical Report No.18, CBIP, New Delhi,
6. Davis, S.N. and De Weist, R.J.M. "Hydrogeology", John Wiley & Sons, N York.
7. Domenico "Concepts and models in Groundwater Hydrology", McGraw Hill Inc. N York
8. Garg, S.P. "Groundwater and Tube Wells", Oxford and IBH Publishing C. N Delhi.

# FREE SURFACE FLOW

**Module I**

Basic Concepts of Free Surface Flow, classification of flow, velocity & pressure distribution. Conservation laws: continuity equation, momentum equation, Velocity and Pressure distribution in channel, Uniform flow, efficient section, Section of constant velocity, Specific energy, Critical depth, Section factor.

**Module II**

First hydraulic exponent M, Second hydraulic exponent Compound section Non-uniform flow, Gradually varied flow, Characteristic of surface profiles, Integration of varied flow equation, Estimation of N and M for trapezoidal channel Rapid varied flow,

**Module III**

Hydraulic jump, classification, location and length of hydraulic jump, jumps in Non rectangular channel, Jumps as energy dissipater.

**Module IV**

Surges in open channel, Positive surges, Negative surges Sharp crested weir, submergence, Ogee spillway: Uncontrolled, Gated, Contraction; Broad crested weir, Sluice gate flow.

**References:**

1. Chow .V.T. “Open Channel Hydraulics”, McGraw Hill . N York
2. Henderson. “Open Channel Flow”, McMillan Pub. London..
3. Subramanya, K “Flow in Open Channels”, Tata McGraw Hill Pub., 1995
4. Grade and Ranga Raju, K.G. “Mechanics of Sediment Transportation and Alluvial Stream Problems”, Wiley Eastem, N Delhi
5. Chaudhry M.H. “Open – Channel Flow”, Prentice Hall of India, N Delhi
6. French, R.H. “Open Channel Hydraulics”, McGraw Hill Pub Co., N York

# ADVANCED FLUID MECHANICS

**Module I**

Description of fluid flow: with reference to translation, rotation and deformation concept of continuum, control mass & control volume approach, Reynolds transport theorem. Steady flow and uniform flow.

**Module II**

Velocity field, one & two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flow net.

Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods.Equations of motion for laminar flow of a Newtonian fluid - Viscous flow – Navier-Stoke's equations, simple exact solutions.

**Module III**

Boundary Layer Theory-Formation, growth and separation of boundary layer-Integral momentum principles to compute drag and lift forces Mathematical models for boundary layer flows.

**Module IV**

Turbulence, Origen of turbulence universal velocity distribution laws of turbulence, smooth rough and transitional turbulent flow in pipes, pipe resistance equation for pipes design of pipe networks. Diffusion and dispersion of pollutants in natural streams.

**References:**

1. Som S. K and Biswas G "Introduction to Fluid Mechanics and Fluid Machines",TMH
2. Schlichting: "Boundary Layer theory", International Text – Butterworth
3. Fox R.W., Pitchard P.J, and Mcdonald A "Fluid Mechanics" Wiley India.
4. Rouse, H. "Advanced Fluid Mechanics", John Wiley & Sons, N York
5. White, F.M. "Viscous Fluid Flow", McGraw Hill Pub. Co, N York
6. Yalin, M.S. "Theory of Hydraulic Models", McMillan Co.
7. Mohanty A.K. "Fluid Mechanics", Prentice Hall of India, N Delhi.

# APPLIED HYDROLOGY

**Module I**

Introduction: Hydrologic Cycle, Systems Concept, Hydrologic model classification. Hydrologic Processes: Reynolds Transport Theorem. Atmospheric circulation: Water Vapour, perceptible water, Thunderstorm cell model. Evaporation: Energy balance method and Aerodynamic method. Evapotranspiration. Subsurface water: unsaturated flow, Richard's equation. Infiltration: Horton's and Phillip's equations. Green-Ampt Method, Ponding time. Surface Water: Hydrograph Analysis, SCS method, Effective Rainfall, Runoff, Runoff Components, Direct Runoff Hydrograph.

**Module II**

Unit Hydrograph Theory: Linear Time Invariant System, Response Functions of Linear Systems, Derivation of Non Parametric Unit Hydrograph From Single Storm and Multi Storm Events, S - Curve Hydrograph, Instantaneous Unit Hydrotherapy.

**Module III**

Rainfall – Runoff Analysis: Review of Rational Methods, Conceptual Models, Parametric Unit Hydrograph, Clarke, Nash and Dooge Models, Hydrologic Simulation Models, Stanford Watershed Model, Derivation of Unit Hydrograph for Ungagged Catchments, Synthetic Unit Hydrograph.

**Module IV**

Hydrologic Time Series Analysis: Independent and Auto correlated Data, Structure of a Hydrologic Time Series, Trend, Jump and Seasonality, Stationarity and Ergodicity, Auto covariance and Auto Correlation Function, Correlogaram Analysis, Spectral Analysis, Analysis of Multivariate Hydrologic Series. Modelling of Hydrologic Time Series: Data Generation Techniques, Linear Stochastic Models, Autoregressive, Moving Average, ARMA Models, Modelling of Nonstationary and seasonal Series, Thomas – Feiring Model, ARIMA Models.

Hydrologic Flood Routing: Reservoir Routing, Channel Routing, Estimation of Parameters of Flood Routing Models, Flood estimation and flood frequency studies, Real Time Flood Forecasting.

**References:**

1. Chow, V.T., Maidment, D.R. and Mays, L.W. "applied Hydrology", McGraw Hill Inc. N York
2. Singh, V.P. "Hydrologic Systems,", Prentice Hall Inc., N York
3. Haan C.T., "Statistical Methods in Hydrology", East West Press, New Delhi
4. Viessman, W., Lewis, G.L. and Knapp, J.W. "Introduction to Hydrology", Harper & Row Publications Inc., Singapore.
5. Ponce, W.F. "Engineering Hydrology", Prentice Hall Inc. N York.
6. Kottegoda "Stochastic Processes in Hydrology", Prentice Hall, Inc., N Jersey
7. Patra K.C "Hydrology and Water resources Engineering", Narosa publishing house, New Delhi.

# FLUVIAL HYDRAULICS

**Module I**

Introduction, nature of sediment problems, origin of sediments, properties of sediment. Incipient motion, tractive force, critical tractive force of different types of sediments, regimes of flow.

**Module II**

Bed load transport, derivation of bed load transport equation based on dimensional analysis, semi-theoretical equations. Suspended load transport, general equation of diffusion, sediment distribution equation, total load transport.

**Module III**

Design of stable channels, factors influencing stable channel design, regime flow theories for design of stable channels, tractive force theory method for design of stable channels.

**Module IV**

Sediment control, methods of sediment control in canal, river training works for control of sediment in rivers and streams, reservoir sedimentation, best management practices for control of reservoir sedimentation.

**Reference Books:**

1. Garde, R.J., “River Morphology”, New International Publishers.
2. Julien, P.Y., “Erosion and Sedimentation”, Cambridge University Press.
3. Jansen, P.P.H., “Principals of River Engineering”, VSSD Publications.
4. Garde, R.J. and Ranga Raju, K.G., "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wiley Eastern Limited.

# Ground Improvement Engineering

**Module I**

Introduction, typical situations where ground improvement becomes necessary, historical review of methods adopted in practice, current status and the scope in the Indian context.

**Module II**

Methods of ground improvement, mechanical compaction, dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, dynamic consolidation, design aspects of stone columns, use of admixtures, injection of grouts, design guidelines and quality control, design examples on preloading with sand drains, road designs with geo-synthetics.

**Module III**

Reinforced earth, basic mechanism, constituent materials and their selection; engineering applications – shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth.

**Module IV**

Geotextiles, selection and engineering applications, design examples, stabilisation/improvement of ground using geomembranes, geocells, geonets, geosynthetic walls.
Soil nailing, construction of underground structures, landslide controls, deep vertical cuts, contiguous piles.
Problematic soils, use of ply soils, improvement of saline soils, improvement of black cotton soils.

**References:**

1) Moseley, M. P. and Kirsch K.,"Ground Improvement", Spon press.
2) Mittal, Satyendra, "Ground Improvement Engineering", Vikas publishing house
3) Koerner, R.M., "Designing with Geosynthetics"' Prentice hall.
4) Saran, S., "Reinforced Soil and Its Engineering Applications", I.K. international.
5) Rao, G.V., Geosynthetics – An Introduction, Sai Master geoenvironmental services.
6) Jones, CJFP, "Earth Reinforcement and soil structure", Thomas Telford.
7) Shukla, S.K., Yin, Jian-Hua, "Fundamentals of Geosynthetic Engineering", Taylor & Francis.

# IRRIGATION AND DRAINAGE

**Module I**

Introduction, objectives of irrigation, type of irrigation and suitability; selection of irrigation method.
Irrigation requirement, water balance, soil water relationships, water storage zone, infiltration. Flow of moisture through root zone, soil physical and chemical properties, crop evaporative and drainage requirements, irrigation efficiency and uniformity.

**Module II**

Surface irrigation systems, types of surface systems, basin irrigation, border irrigation, furrow irrigation, field measurement techniques, flow measurement, flumes, weirs, irrigation events, advance, wetting, depletion and recession phases.

**Module III**

Infiltration, infiltrometer, ponding methods, soil water, tensiometers, neutron probe, time domain reflectometer, evapotranspiration, crop coefficient, leaf area index, FAO guide lines on evapotranspiration estimation.

**Module IV**

Fundamentals of surface irrigation hydraulics, continuity equation, momentum equation Hydrodynamic model, zero inertia model, kinematic wave model. Drainage principles, need for drainage, steady state equations, Hooghoudt, Kirkham, Dagan and Ernst equations.

Salt balance, water and salt balance of the root zone, salt equilibrium equation and leaching requirement, leaching efficiency.

**Reference Books:**

1. Walker, W.R., and Skogerboe, G.V., "Surface Irrigation Theory and Practice", Prentice Hall, INC.
2. Drainage Principles and Applications, "International Institute for Land Reclamation and Improvement", Wageningen.
3. Michael, A.M., "Irrigation: Theory and Practice", Vikas Publishing House.
4. Asawa, G.L., "Irrigation Engineering", New Age International Publishers.
5. Majumdar, D.K., “Irrigation Water Management”, PHI Learning.
6. Luthin, J.N., "Drainage Engineering", John Wiley.

# DESIGN OF IRRIGATION STRUCTURE

**Module I**

Concrete Dams: Investigation and Planning. Forces on Concrete dams, Types of loads, Stability analysis. Safety criteria, Gravity analysis, Internal stress calculation and Galleries. Joints and keys and cooling arrangement. Water stops at joint, closing gaps. Buttress and Arch Dam. Mass concrete for dams: Properties and quality control. Pressure grouting.

**Module II**

Spillway: Types, Design principles of Ogee spillway, side channel spillway, Chute spillway, Syphon Spillway, shaft Spillway, Gates & Valves. Energy dissipators and stilling basin design. Outlet works.

**Module III**

Earth and rock fill Dams : subsurface explorations methods, cut off trenches, sheet piling cutoffs, upstream blankets, horizontal drainage blankets and filters, toe drains and drainage trenches, pressure relief well. Seepage through embankments, Stability analysis of slopes of homogeneous and zoned embankment type under different reservoir conditions, Upstream and downstream slope protection measures.

**Module IV**

Diversion Head works: Components, Weir, Design of impervious floor, Khosla's theory Canal Regulations works: Canal Fall, its type and design methods, Canal outlets.

**References:**

1. Varshney R.S. "Concrete Dams", Oxford & IBH Publication Co..
2. Stewart L., Flayd E. Dominy " Design of Small Dams", Oxford & IBH Publication Co..
3. Punmia B.C. Lal B.B. Pande, Jain A. K. Jain A. K. "Irrigation and Water Power Engineering", Laxmi Publications (P) Ltd.

# GIS AND REMOTE SENSING

**Module I**

Remote sensing- Introduction, physics of remote sensing- electromagnetic radiations and their characteristics, thermal emissions, multi-concept in remote sensing, remote sensing satellites and their data products, sensors and orbital characteristics, spectral reflectance curves for earth surface features, methods of remotely sensed data interpretation- visual interpretation, concept of fcc, digital image processing- digital image and its characteristics, satellite data formats, image rectification and restoration, image enhancement- contrast manipulation, spatial feature manipulation, multi-image manipulation

**Module II**

Fundamentals of GIS: introduction, definition of GIS, evolution of GIS, roots of GIS, definition, GIS architecture, models of GIS, framework for GIS, GIS categories, map as a model, spatial referencing system, map projections, commonly used map projections, grid systems, cartographic symbolization, types of maps, typography, map design, map productions, map applications, data management,Models and quality issues: conceptual models, geographical data models, data primitives, data types - raster and vector approach, digital terrain modelling , approaches to digital terrain data modelling , acquisition of digital terrain data, data modelling and spatial analysis, sources of geographical data, data collectors and providers, creating digital data sets, data presentation, data updating, data storage

**Module III**

GIS data processing, analysis and visualization: raster based GIS data processing, vector based GIS data processing, human computer interaction and GIS, visualization of geographic information, principles of cartographic design in GIS, generation of information product, image classification and GIS, visual image interpretation, types of pictorial data products, image interpretation strategy, image interpretation process, Rainfall runoff modelling using remote sensing inputs,

**Module IV**

Flood and Drought Studies – Flood plain zoning –inundated areas – evaluation models – Drought assessment and Monitoring. Command Area Studies –Cropping patterns, conditions of crops, irrigation system performance – crop yield estimation.

**References:**

1. Meijerink A.M.J., H.A.M. de Brouwer, C.M. Mannaerts and C.R. Valenzuela, “Introduction to the use of Geographic Information Systems for Practical Hydrology”, ITC Publication, Paris.
2. Lillesand T.M. and Kiefer R.W., “Remote Sensing and Image Interpretation”, John Wiley and Sons,N York.
3. Swain P.H., and S.M. Davis, “Remote Sensing – The Quantitative Approach”, McGraw Hill Publishing Company, N York.
4. Reddy M.A “Remote Sensing And GIS”, , B.S. Publication, Hyderabad
5. Kang-Tsung Chang “Introduction Of GIS” , Tata Mcgraw-Hill, New Delhi
6. Lyon, J.G. and Mc Larthy, J. “Wetland and Environmental Application of GIS”, Lewis Publishers,Washington.

# WATER SUPPLY SYSTEMS

**Module I**

Instructions: Water Requirements, Sources of Water, Water Supply Considerations, Water Quality, Drinking Water Standards Secondary Standards – Toxic Water Pollutants, Quality Criteria for Surface Water, Purpose of Water Treatment – Selection of Water Processes , Water – Processing Sludges.

**Module II**

Conventional treatment Processes: Sedimentation, Type of Sedimentation, Zone Setting, Filtration, Gravity Granular-Media Filtration, Head Losses, Back Washing and Media Fluidization – Pressure Filters – Slow Sand Filters, Coagulation and Flocculation Coagulants, Coagulants, Coagulant Aids, Rapid Mixing Devices, Disinfection, Disinfection Methods, CI2 handling and Dosage, Control of Thms, Fluoridation, Defluoridation.

**Module III**

Water Softening: Lime soda Process, Variations-Ion Exchange Softening and Nitrate Removal. Iron and Manganese Removal: Iron Corrosion, Water Stabilization-Cathodic Protection.

**Module IV**

Taste and Odour: Methods for Control, Aeration, Adsorption, Control of Algae Growth.
Reduction of Dissolved Salts: Distillation, Reverse Osmosis, Electro dialysis.
Transportation and Distribution of Water: Aqueducts, Hydraulic Consideration, Design of Transportation System, Distribution Reservoirs and Service Storage.

**References**

1. Viessman Jr., Mark J. Hammer “Water Supply and Pollution Control”. Mc Graw Hill International Edition.
2. Peavy, H.S., H.S., Row, D.R. and Tchobanaglous, G. “Environmental Engineering”. Mc Graw Hill International Edition.
3. Fair, Geyer, Okun “Water Supply Engineering”. John Wiley.
4. Turbuit T H Y “Principles of Water Quality Control”, Pergamon Press.

# WATER RESOURCES SYSTEM AND MANAGEMENT

**Module I**

Introduction: General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of Water Resources Planning and Development, Nature of Water Resources Systems, Socio Economic Characteristics.

**Module II**

Economic Analysis of Water Resources System: Principles of Engineering Economy, Capital, Interest and Interest Rates. Time Value of Money, Depreciation, Benefit Cost Evaluation, Discounting Techniques, Economic and Financial Evaluation, Socio-Economic Analysis.

**Module III**

Methods of Systems Analysis: Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models, Classical Optimisation Techniques, Gradient Techniques, Stochastic Programming, Simulation, Search Techniques, Multi Objective Optimisation.

**Module IV**

Water Quantity Management: Surface Water Storage Requirements, Storage Capacity and Yield, Reservoir Design, Water Allocations for Water Supply, Irrigation, Hydropower and Flood Control, Reservoir Operations, Planning of an Irrigation System, Irrigation Scheduling, Groundwater management, Conjunctive Use of Surface and Subsurface Water Resources, Design of Water Conveyance and Distribution Systems.

**References:**

1. Loucks, D.P., Stedinger, J.R. and Haith, D.A. “Water Resources Systems Planning and Analysis”,Prentice Hall Inc. N York
2. Chaturvedi, M.C. “Water Resources Systems Planning and Management”, Tata McGraw Hill Pub.Co., N Delhi.
3. Hall. W.A. and Dracup, J.A. “Water Resources Systems”, Tata McGraw Hill Pub. N Delhi
4. James, L.D. and Lee “Economics of Water Resources Planning”, McGraw Hill Inc. n York
5. Kuiper, E. “Water Resources Development, Planning, Engineering and Economics”, Buttersworth, London
6. Biswas, A.K. “Systems Approach to Water Management”, McGraw Hill Inc. N York
7. Major, D.C. and Lenton, R.L., “Applied Water Resources System Planning”, Prentice-Hall Inc,N.Jersey
8. Taha h A, “Operations Research”, Prentice Hall of India, N Delhi.

# COMPOSITE STRUCTURES

**Module I:**

Introduction: definition and characteristics, fibres, matrices, fibre reinforced composites, advantages and limitations, basic concepts and characteristics: isotropy, orthotropic, classification, lamina and laminate, micromechanics and micromechanics, constituent materials and properties.

**Module II:**

Elastic behaviour of unidirectional lamina: specially orthotropic and transversely isotropic material, relation between mathematical and engineering constants, stress strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, transformation of stress-strain relations in terms of engineering constants.

**Module III:**

Elastic behaviour of multidirectional laminates, symmetric and balanced laminates, design considerations, computational procedure for finding engineering elastic properties, stress and failure analysis of multidirectional laminates.

**Module IV:**

Bending of laminated composite plates, thin laminated plate theory, deflection of all edges simply supported rectangular symmetric cross-ply laminate, two opposite edges simply supported.

**Books:**

1. I.M. Daniel & O. Ishai, “Engineering Mechanics of Composite Materials", Oxford Press
2. S.W.Tsai & H.T.Hahn, "Introduction to Composite Materials: Techonomic Pub. Co.INC, USA.
3. P.K.Sinha,"A short term course on Composite Materials and Structures"-1996

# HYDRO POWER ENGINEERING

**Module I:**

Instruction: Sources of Energy, Status of hydro power in the World. Transmission Voltages and Hydro-power, estimation of water power potential, General load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power, secondary power, prediction of load.

**Module II:**

Classification of Hydel Plants: Run off river plants, general arrangement of run off river plants, valley dam plants, diversion canal plants, high head diversion plants storage and pondage, Pumped storage plants: Types of Pumped storage plants, relative merits of two unit and three unit arrangement. Three unit arrangement, reversible pump turbines, problems of operation, power house, efficiency of P-S plants.

**Module III:**

Water Conveyance: Classification of penstocks, design criteria for penstocks, economical diameter of penstock, anchor blocks, conduit valves, types of valves, bends and manifolds, illustrative, water hammer, resonance in penstocks, channel surges, surge tanks. Intakes: Types of intakes, losses of intakes, air entrainment at intakes, inlet aeration, canals fore bay, tunnels. Turbines: Introduction, types of turbines, hydraulic features, turbine size, constructional features of turbines, layout arrangements, hydraulic of turbines, basic flow equations, draft tubes, cavitations in turbines, governing of turbines, characteristics of turbines, illustrative examples.

**Module IV:**

Power House Planning: Surface power stations: power house structure, power house dimensions, lighting and ventilation, variations in design of power house. Underground power station: Location of U.G. power station, Types of U.G. power stations, advantages of U.G. power house, components of U.G. power house, types of layout, limitations of U.G. power house structural design of power house. Tidal power: Basic principle, location of tidal power plant, difficulties in tidal power generation, components of tidal power plants, modes of generation, single basin arrangement, double basin system.

**References:**

1. Water Power Engineering by M.M. Dandekar and K.N. Sharma, Vani Educational Books
2. Irrigation and water resources Engg. By G.L. Asawa, New Age international Publishers.
3. Irrigation and water power Engineering by B.C. Punamia, Pande B.B. Lal (Laxmi Publications Private Limited)

# NON-CONVENTIONAL ENERGY

**Module I**

Introduction various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. 3 Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

**Module II**

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**Module III**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. 4 Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. 2 Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

**Module IV**

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. 2 Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.
Bio-mass: Availability of bio-mass and its conversion theory. 2 Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

**References Books:**

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.
2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “ Energy Resources: Conventional & Non-Conventional “ BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International. 5.
C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.

# ADVANCED NUMERICAL METHODS

**Module I:**

Introduction to digital computers & Programming - an overview; Errors - polynomial approximations and interpolations - Numerical differentiation & Integration;

**Module II:**

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods. Matrices – Linear equations, Eigenvalues and Eigenvectors - nonlinear equations,

**Module III:**

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

**Module IV:**

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

**Referrences**

1. Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg.Computation".
2. Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".
3. Gerld C.F and PO Wheatley "Applied Numerical Analysis".
4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.
5. Johnson R.A " Probability and Statistics for Mngineers.
6. Rajeshwaran S, "Numerical Methods in Science & Engineering (A Practical Approach)",Willey Publication.

# Green Building Concepts

**Module I**

Environmental implications of buildings energy, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transporation Energy for Building Materials; Maintenance Energy for Buildings.

**Module II**

Implications of Building Technologies Embodied Energy of Buildings: Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

**Module III**

Comforts in Building: Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

**Module IV**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings. Unit V Green Composites for buildings: Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**TEXT BOOKS**

[1] K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
[2] Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
[3] Green My Home!: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint, by Dennis C. Brewer, ISBN:9781427798411, Publisher: Kaplan Publishing, Publication Date: October 2008.
[4] B. Givoni, Man, Climate and Architecture Elsevier, 1969.
[5] T. A. Markus and E. N. Morris Buildings Climate and Energy. Pitman, London, 1980. Arvind Kishan et al (Ed)
[6] Climate Responsive Architecture. TataMcGraw Hill, 2001.
[7] Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
[8] O. H. Koenigs Berger, T. G. Ingersoll, Alan Mayhew and S. V. Szokolay. Manual of Tropical Housing and Building. Orient Long man, 1975.

**REFERENCE BOOKS**

[1] Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
[2] Michael F. Ashby Materials and the Environment, Elsevier, 2009.
[3] Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
[4] Mili M. Ajumdar (Ed) Energy Efficient Building in India. Teri and Mnes, 2001/2002.
[5] T. N. Seshadri et al Climatological and Solar Data for India. CBRI and Sarita Prakashan, 1968. 34
[6] Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

[7] The New Solar Electric Home: The Photovoltaics How-To Handbook, by Joel Davidson, ISBN: 9780937948095, Publisher: Aatec Publications, Publication Date: July 1987.