Ph.D. Course work

Pre-Ph.D. Examination Syllabus

DEPARTMENT OF CIVIL ENGINEERING,
K L UNIVERSITY,
VADDESWARAM - 522502, ANDHRA PRADESH, INDIA.

KL UNIVERSITY
Green Fields, Vaddeswaram.

List of Pre-Ph.D Courses approved by
DEPARTMENT OF
CIVIL ENGINEERING

S.NO	PAPER – 2	Code	PAPER – 3	Code
1.	Sustainable Construction Materials and Methods	21 CE 201	Advanced Concrete Technology	21 CE 301
2.	Finite Element Analysis	21 CE 202	Advanced Design of Structures	21 CE 302
3.	Optimization Techniques	21 CE 203	Advanced Structural Mechanics	21 CE 303
4.	Structural Dynamics	21 CE 204	Remote Sensing and Geographic Information System	21 CE 304
5.	Advanced Wastewater Treatment	21 CE 205	Surfaces Hydrologic Systems	21 CE 305
6.	Water Quality and Environment	21 CE 206	River Hydraulics	21 CE 306
7.	Hydrologic Elements and Analysis	21 CE 207	Watershed and Wetland Management	21 CE 307
8.	Geosynthetics	21 CE 208	Ground Improvement Techniques	21 CE 308
9.	Geotechnical Earthquake Engineering	21 CE 209	Pavement Construction and Management	21 CE 309
10.	Traffic Engineering	21 CE 210	Environmental Impact Assessment	21 CE 310

Code: 21 CE 201

K L UNIVERSITY

SUSTAINABLE CONSTRUCTION MATERIALS AND METHODS

L-T-P-S: 3-0-0-0

SYLLABUS

UNIT – I

Basics of Sustainable construction engineering

Fundamentals of Sustainable Construction Engineering- Sustainability and resources, need, present practices at national and international level, The Sustainability Quadrant- challenges & Issues, Government initiatives.

UNIT – II

Sustainable construction Materials

Overview of sustainable construction materials, Consideration of physical, mechanical and thermo physical properties, Selection criteria for design of sustainable construction materials

UNIT – III

Construction Product, Process Design and Development

Sustainability of construction resources, process modifications, product performance evaluation

UNIT – IV

Sustainability assessment using standard approaches LEED/GRIHA rating evaluation process's-economic feasibility of sustainable construction products, Innovative & customized sustainable product design based on social constraints; tools & aids available for sustainable construction products.

UNIT – V

Life Cycle Assessment: Life Cycle Assessment and Costing-Various aspects related to construction cost, present value analysis, life cycle stages, cost calculation & measures, evaluation criteria, uncertainty assessment, sensitivity analysis, break even analysis.

Recommended References:

1. Sustainable Engineering Practice ASCE Publication 2010.
2. Hagger Sustainable Industrial Design and Waste Management, Techniz Book 2010.
3. Helmut Rechberger, Practical handbook of Material Flow Analysis, Taylor & Francis. 2010.
4. Michael Z. Hou, Heping Xie, Jeoungseok Yoon Underground Storage of CO2 and Energy Taylor &Francis, 2010.
5. LEED for India: Reference Guide, 2011.
6. Whole Building Life Cycle Assessment: Reference Building Structure and Strategies.

Code: 21 CE 301

ADVANCED CONCRETE TECHNOLOGY

L-T-P-S: 3-0-0-0

UNIT I

Composition of OPC – Manufacture – Modified Portland Cements – Hydration Process of Portland Cements – Structure of Hydrated Cement Pastes Mineral Admixtures – Slags – Pozzolanas and Fillers – Chemical Admixtures –Solutes – Retarders – Air Entraining Agents – Water Proofing Compounds – Plasticizers and Super Plasticizers Aggregates – Properties and testing of fine and course aggregates – combining of aggregates – Substitute material for aggregates – recent advancements.

UNIT II

Concrete Mix Design:
Mix Proportioning (As per IS method, ACI method, British Method)– Mixes incorporating Fly ash, Silica fume, GGBS.
Mechanical Properties of Concrete:
Interfacial Transition Zone – Fracture Strength – Compressive strength – Tensile strength - Impact strength - Bond strength, modulus elasticity, modulus of rupture.

UNIT III

Special Concretes:
High Performance Concrete – High strength concrete – variations in concrete strength Fibre Reinforced Concrete – Self Compacting Concrete – Polymer Concrete – High performance concrete – lightweight concrete – pervious Concrete- Introduction to heavy weight aggregate concrete, Introduction to geo-polymer concrete.

UNIT IV

Durability of Concrete:
Factors affecting durability – Chemical Attack – Permeability – chloride penetration –water absorption – creep – Shrinkage, carbonation, corrosion. Service Life Prediction: Introduction to service life prediction. Design of Concrete for the required Service Life

UNIT V

Non destructive evaluation: Importance- Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods- Corrosion activity measurement- chloride content – Depth of carbonation- Impact echo methods- Ultrasound pulse velocity methods- Pull out tests.

Text Books:

1. Concrete technology- Neville & Brooks
2. Special Structural concrete- Rafat Siddique
3. Concrete repair and maintenance illustrated- Peter H Emmons
4. Gambhir.M.L., Concrete Technology – Tata McGraw Hill Book Co. Ltd., Delhi, 2004
5. Concrete technology-M S Shetty
6. Santhakumar. A.R., Concrete Technology, Oxford University press, New Delhi. 2007.
7. MethaP.K. and Montreio P.J.M., Concrete Structure Properties and Materials, Prentice Hall, 1998.
8. Gupta.B.L. and Amit Gupta, Concrete Technology, Standard Publishers Distributer, New Delhi, 2004.

Code: 21 CE 302

ADVANCED DESIGN OF STRUCTURES
L-T-P-S: 3-0-0-0

UNIT-I
Introduction: Analysis and design of portal frames, Design example for hinged and fixed frame.

UNIT-II
Design of combined footing and strap footing, Design of Cantilever and Counterfort retaining wall

UNIT-III
Elevated water tanks: Introduction, Analysis & Design of INTZ Tanks including staging and continuous deep beams.

UNIT-IV
Yield line method of design of slabs. Design of flat slabs. Design of grid floors

UNIT-V
Introduction to plastic analysis: stress strain relationship of Mild steel, Elastic design versus

Ultimate load design, Plastic bending of beams, Shape factor, Load factor, Plastic analysis, Procedure for plastic analysis, Design consideration

Text Book:
Advanced Reinforced Concrete Design, by N.Krishna Raju, CBS publishers, 2009.

Reference Books:

1. Advanced Reinforced Concrete Design by Varghese,Pentice Hall India, 1st edition 2004.
2. Advanced Reinforced Concrete Design (vol-II) by S. S. Bhavikatti, New age international, 2nd edition, 2009.
3. Design of steel structures by L.S Negi Tata Mc Graw Hill publishing company Limited, 2nd edition, 1997

Code: 21 CE 205

ADVANCED WASTEWATER TREATMENT
L-T-P:3-0-0

Importance of Advanced Wastewater Treatment: Effects of chemical constituents in wastewater / Basis of process selection and development of treatment flow sheets

B**iological Nutrient Removal:** Sources and forms of Nitrogen (N) and Phosphorus (P) / Conventional biological nitrification/ denitrification processes and its process fundamentals. Sequencing Batch Reactor (SBR) and Simultaneous Nitrification – Denitrification (SND) processes for nitrogen removal.

Advanced Process for Nitrification –Denitrification: New processes for nitrogen removal: ANAMMOX, SHARON, CANON etc. Biological removal of Phosphorus-Process fundamentals and types of processes. Combined removal of N and P by biological methods

Chemical Nutrient Removal: Nitrogen removal by physical and chemical methods- Air stripping of ammonia / Breakpoint Chlorination / Ion – exchange. Removal of phosphorus by chemical addition.

Refractory Organics and Dissolved Inorganic Substance Removal: Advanced Oxidation Processes (AOP)/ Adsorption / Chemical precipitation / Ion Exchange / Membrane Processes.

Wastewater Reclamation/Reuse/Disposal: Direct and indirect reuse of wastewater- Municipal reuse/industrial reuse/agricultural reuse/recreational reuse/ground water recharge. Criteria and disposal of effluent in to lakes, rivers and ocean. Membrane Bio-Reactor (MBR) applications.

Biodegradation: Microbial degradation of biopolymers and Hydrocarbons – Eco-technologies – Wetland process.

Text Books:

1. Metcalf & Eddy (2009), Wastewater Engineering- Treatment, Disposal and Reuse, Second edition, Tata McGraw-Hill, New Delhi.
2. Peavy, Rowe &Tchobanoglous (2010), Environmental Engineering, Tata McGraw-Hill, New Delhi.

Reference:

Reference Books:

1. 'Wastewater Treatment Plants: Planning, Design and Operation' authored by Syed R. Qasim, Edward M. Motley and Guang Zhu, 2nd Edition, CRC Press, 2015 (ISBN: 1-56676-688-5).

2.'Water and Wastewater Calculations Manual' authored by Shun Dar Lin and C. C. Lee, 2nd Edition, The McGraw-Hill Companies, Inc, 2007 (ISBN: 0-07-154266-3).

3. Handbook of Water and Wastewater Treatment Plants Operations' authored by Frank R. Spellman, 3rd Edition, CRC Press, 2014 (ISBN-13: 978-1-4665-5338-5).

4. 'Water and Wastewater Engineering: Design Principles and Practice' authored by Mackenzie L.

Code: 21 CE 306

RIVER HYDRAULICS

L-T-P-S: 3-0-0-0

Unit – 1

Basic concepts of free surface flow, Flow regimes, Velocity and Pressure distribution, Energy principles and its applications, Specific energy, Critical flow computations, Momentum equations and its applications, Specific force diagram, Theoretical concepts of surface roughness, Velocity equation, Uniform flow computation

Unit – 2

Steady gradually varied flow, Dynamic equation, Characteristics of flow profile and methods of computation, Practical problems, Gradually varied flow classification, analysis and computations, Compound channels, Canal delivery problem, Channel networks

Unit – 3

Steady rapid varied flow, Hydraulic jump analysis and location, Jump in sloping channels and Oblique jump, Surge analysis, Design of spillways, Energy dissipaters, Channel transitions. Unsteady rapidly varied flow, Monoclinal rising wave, Dam break problem, Moving hydraulic jump, Positive and Negative surges, Hydrualic flood routing

Unit – 4

Fluvial hydraulics, Basic characteristics of river beds and sediments, Initiation of motion, Bed load, suspended load, total load and sediment measurements, Regimes of flow, Plan form and stream bed variations of rivers, Sediment control.

Unit – 5

Design of stable channels, Design of erodible and lined channels for clear and sediment – laden flows – CBI & P method, Regime method, Tractive force methods, Reservoir sedimentation, Erosion and deposition, Sediment transport in pipes Similitude and models, Dimensional analysis and similitude, Scale ratios, Fixed – bed and movable bed models

Reference Books

1. Chow V.T. “Open Channel Hydraulics”, McGraw Hill, Inc. New York.
2. Henderson “Open channel flow”, McMillan Pub. London
3. Subramanya K. “Flow in Open Channels”, Tata McGraw Hill Pub.
4. Garde and Ranga Raju K.G. “Mechanics of sediment transportation and Alluvial Stream Problems”, Wiley Eastern, New Delhi
5. Chaudhry M.H. “Open – Channel Flow”, Prentice Hall of India, New Delhi
6. French R.H. “Open Channel Hydraulics”, McGraw Hill Pub Co., New York

Code: 21 CE 310

ENVIRONMENTAL IMPACT ASSESSMENT

L-T-P-S: 3-0-0-0

UNIT-I

Introduction: Environment and its interaction with human activities Environmental imbalances Attributes, Impacts, 'Indicators and Measurements - Concept of Environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA

UNIT-II

Environmental Indicators - Indicators for climate - Indicators for terrestrial subsystems -Indicators for aquatic subsystems - Selection of indicators - Socia-economic indicators – Basic information - Indicators for economy - Social indicators - Indicators for health and nutrition - Cultural indicators - Selection of indicators.

UNIT-III

Environmental issues in water resource development - Land use - Soil erosion C1nd their short- and long-term effects - Disturbance and long-term impacts - Changes in quantity and quality of flow ¬Sedimentation –Environmental impact assessment of water resource development structures – Gase studies,Water Quality Impact Assessment - Attributes, Water Quality Impact Assessment of Water

UNIT-IV

Resources Projects, Data Requirements of Water Quality Impact Assessment for Dams, Impacts of Damson Environment, Case Studies. Environmental Issues in Industrial Development: On-site and Off-site impacts during various stages of industrial development, Long term climatic changes, Greenhouse effect, Industrial effluents and their impact on natural cycle, Environmental impact of Highways, Mining' and Energy development

UNIT-V

Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies Ad hoc, Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing A Methodology, Review Criteria.

REFERENCES:

1. Jain, R.K., Urban, L.V., Stracy, G.S., (1991), "Environmental Impact Analysis", Van Nostrand Reinhold Co., New York

2. Rau, J.G. and Wooten, D.C., (1996), "Environmental Impact Assessment", McGraw Hill Pub. Co.,New York

3. UNESCO, (1987), "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", UNESCO/UNEP, Paris

4. Canter, L.W., (1997), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York.

Code: 21 CE 202

FINITE ELEMENT ANALYSIS
L-T-P-S: 3-0-0-0

UNIT-I
Basic Principles
Equilibrium equations; Strain-displacement relations; linear constitutive relations; Principle virtual work; Principle of stationary potential energy

UNIT-II
Element Properties
Different types of elements; Displacement models; Relation between nodal degrees of freedom and generalized coordinates; Convergence requirements; Compatibility requirement; Geometric invariance; Natural coordinate systems; Shape functions; Element strains and stresses; Element stiffness matrix; Element nodal load vector. Isoparametric elements – Definition, Two-dimensional isoparametric elements – Jacobian transformation, Numerical integration

UNIT-II
Direct Stiffness method and Solution Technique
Assemblage of elements–Obtaining Global stiffness matrix and Global load vector; Governing equilibrium equation for static problems; Storage of Global stiffness matrix in banded and skyline form; Incorporation of boundary conditions; Solution to resulting simultaneous equations by Gauss elimination method

UNIT-IV
Plane-stress and Plane-strain analysis
Solving plane stress and plane-strain problems using constant strain triangle and four nodded isoparametric element

UNIT-V
Analysis of plate bending
Basic theory of plate bending; Shear deformation plates; Plate bending analysis using four noded isoparametric elements

Text Books:

1. Introduction to Finite Elements in Engineering by R.T. Chandrupatla and A.D. Belegundu, Prentice Hall of India, 1997.

Reference Books:

1. Finite Element Analysis by Abel and Desai, New Age Publishers, 2007.
2. Finite Element Analysis: Theory and Programming by C. S. Krishnamoorthy, Tata McGraw-Hill, 1995
3. Finite Element Procedures in Engineering Analysis by K. J. Bathe, Prentice Hall Inc., 1996.
4. The Finite Element Method by O.C. Zienkiewicz, and R.L.Taylor, McGraw – Hill, 1987.

Code: 21 CE 208

GEOSYNTHETICS
L-T-P-S: 3-0-0-0

UNIT – 1 Geosynthetics

Introduction to Geosynthetics – Basic description – History – Manufacturing methods – Uses and Applications.
Properties and Testing Methods: Properties and Testing methods of Geotextiles – Geogrids – Geomembranes – Geocomposites.

UNIT – 2 Geotextiles
Designing for Separation – Reinforcement – Stabilization – Filtration – Drainage and Moisture barriers.

UNIT – 3 Geogrids
Designing for Reinforcement – Stabilization – Designing Gabions – Construction methods – Design of retaining walls.

UNIT- 4 Geomembranes
Survivability Requirements – Pond Liners – Covers for Reservoirs – Canal Liners – Landfill Liners – Caps and closures – Dams and Embankments.

UNIT- 5 Geocomposites
Geocomposites – An added advantage – Geocomposites in Separation – Reinforcement– Filtration – Geocomposites as Geowebs and Geocells – Sheet drains – Strip drains and Moisture barriers.

TEXT BOOKS:
1. "Engineering with Geosynthetics", by G. Venkatappa Rao and GVS Suryanarayana Raju – Tata McGraw Hill Publishing Company Limited – New Delhi.

REFERENCE BOOKS:
1. "Designing with Geosynthetics by Robert M. Koerner Prantice Hall, Eaglewood cliffs, NJ 07632.
2. "Construction and Geotechnical Engineering using Synthetic Fabries" by Robert M. Koerner and Josoph P. Welsh. John Willey and Sons, New York.
3. "Foundation Analysis and Design" by J.E. Bowles McGraw Hill Publications.

Code: 21 CE 209

GEOTECHNICAL EARTHQUAKE ENGINEERING
L-T-P-S: 3-0-0-0

UNIT-I

Seismology and Earthquakes

Introduction, Seismic Hazards, seismic waves, internal structure of earth, Continental drift and plate tectonics, faults, elastics rebound theory, geometric notations, location of earthquakes, size of earthquakes.

Strong Ground Motion

Strong ground motion measurement, ground motion parameters, estimation of ground motion parameters.

Seismic Hazard Analysis: Identification and Evaluation of Earthquake Sources, deterministic seismic hazard analysis, probabilistic seismic hazard analysis.

UNIT-II

Wave propagation

Waves in unbounded media, waves in a semi – infinite body, waves in a layered media, attenuation of stress waves.

UNIT-III

Dynamic soil properties: Measurement of dynamic soil properties using field and laboratory tests (overview), stress strain behavior of cyclically loaded soils, strength of cyclically loaded soils.

UNIT-IV

Ground Response Analysis

One – Dimensional Ground response Analysis – Linear and Non-Linear Approaches.

Local Site Effects: Effect of local site conditions on ground motion, design parameters, development of design parameters.

UNIT-V

Liquefaction

Flow liquefaction, cyclic mobility, evaluation of liquefaction hazards, liquefaction susceptibility, initiation of liquefaction, effects of liquefaction.

Soil Improvement for Remediation of Seismic Hazards: Densification techniques, Reinforcement Techniques, Grouting and Mixing techniques, Drainage techniques.

TEXT BOOK:

1. Geotechnical Earthquake Engineering by Steven L. Kramer, prentice Hall, 1st edition, 1996.

REFERENCE BOOK:

1. Geotechnical Earthquake Engineering Handbook by Robert W. Day, McGraw-Hill.2nd edition, 2010.

Code: 21 CE 308

GROUND IMPROVEMENT TECHNIQUES

L-T-P-S: 3-0-0-0

UNIT – 1

Necessity of ground improvement- objectives, Introduction to different methods - Mechanical stabilization- Types of rollers, effect on engineering properties- Chemical stabilization- cement stabilization- factors affecting soil cement mixing-admixtures- lime stabilization-effect of lime on soil properties-construction of lime stabilized bases-bituminous stabilization

UNIT-2

Dewatering-well-point system-electro osmosis-pre-loading- sand drains- methods of installation - PVD's, Types, Design, construction -stone columns in clays - vibro-flotation in sands and clays, Designs as per BIS and case histories

UNIT-3

Introduction to grouts and grouting- basic functions – groutability ratio –classification of grouts- properties of grouts - grouting applications- Impermeability grouting seepage control in soil under dams and for cut off walls- seepage control in rock under dams-stabilization grouting for under pinning.

UNIT-4

Geosynthetics – Types, functions, typical Applications of filtration and drainage, use in road /airport pavements and strengthening existing pavements

UNIT-5

Earth Reinforcement- mechanism and concept - laboratory behavior of reinforced soil-Reinforced Soil retaining Structures – Types of Reinforcements, fascia and connections - design concepts and stability analysis – Use in India

TEXT BOOKS:

1. IRC (1995). Ground Improvement Techniques
2. Stabilization of clays, Indian Raods congress, New Delhi , Spl Publication No. Venkatappa Rao, G and Ramana, G.V. (2000
3. Relevant I.S.Codes

REFERENCES :

1. Bowles, J.F. Foundation Design
2. Das, B.M, Geotechnical Engineering
3. Jones, C.J.F.P.Earth Reinforcement and Soil structures
4. Koerner, R.M. (2005) Designing with Geotextiles,

Code: 21 CE 207

HYDROLOGIC ELEMENTS AND ANALYSIS
L-T-P-S : 3-0-0-0

UNIT-I
INTRODUCTION
Historical background, hydrological cycle, hydrologic problems, water balance.

Precipitation: - Definition, types, forms, measurement – network design, Non-recording and recording (automatic) precipitation gauges. Analysis of data , Supplementing missing data, consistency of record, hyetograph, mass curve analysis, depth areas duration analysis. Rainfall frequency analysis , Station year method.FAO(24)

UNIT-II

Evapotranspiration:- Evaporation, transpiration, evapotranspitation, Factors affecting, measurement, network design, estimation of evaporation and evapotranspiration , Evaporation retardation.

UNIT-III

Infiltration:- Capacity, rates and indices, factors affecting, measurement of infiltration , estimation of infiltration capacity from hydrograph analysis.phillips method,green model,

Hydrometry :- Measurement of discharge, selection of site for stage and discharge measuring station non-recording and recording gauges, Accuracy and frequency of observed data, discharge measurement by area Velocity method and slope area method , Chemical methods.

UNIT-IV

Runoff :- Runoff, runoff cycle, components of runoff, factors affecting runoff , storage effects of runoff from snowmelt, Estimation of average monthly and annual runoff , rainfall - runoff relationships. SCS method

UNIT-V

Hydrograph and its components: Master recession curve, Base flow and its separation ,linear system pulse response, Unit hydrograph theory and its application for isolated and complex storms , Synthetic unit hydrograph, S- curve, Unit hydrograph of varied durations, Instantaneous unit hydrograph, conceptual models.

Computation of peak flow:- Rational and Empirical relationships, Flood frequency analysis, Recurrence interval design flood.probabulity distance for hydrologic variation **Flood routing**: Routing through reservoirs and channels , Graphical Methods.

TEXT BOOKS:

1. Ven-Te Chow, David R. Maidment, Larry W. Mays; Applied Hydrology Mc Graw hill Publications, 1995.
2. Vijay P. Singh ;Elementary Huydrology, Prentice hall of India, 1994.
3. H.M. Ragunath; Hydrology, Wily Eastern Ltd, 1996.
4. Ven-Te Chow et al. Handbook of Applied Hydrology; Mc Graw Hill Publication, 1995.

Code: 21 CE 203

OPTIMIZATION TECHNIQUES

L-T-P-S : 3-0-0-0

UNIT 1

Introduction: Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.

UNIT 2

Linear Programming: Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming.

UNIT 3

Non-linear programming: Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods

UNIT 4

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different techniques

UNIT 5

Geometric programming: Geometric programming, conversion of NLP as a sequence of LP/ geometric programming.

Dynamic programming: Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming

REFERENCE BOOKS:

1. Spunt, “Optimum Structural Design”- Prentice Hall
2. S.S. Rao, “Optimization – Theory and Practice”- Wiley Eastern Ltd.
3. Uri Krisch, “Optimum Structural Design”- McGraw Hill
4. Richard Bronson, “Operation Research”- Schaum’s Outline Series
5. Bhavikatti S.S.- “Structural optimization using sequential linear programming”- Vikas publishing house

Code: 21 CE 309

PAVEMENT CONSTRUCTION AND MANAGEMENT
L-T-P-S : 3-0-0-0

UNIT-I PAVEMENT MANAGEMENT SYSTEM:
Components of PMS and their Activities, Major Steps in Implementing PMS, Inputs, Design,Construction and Maintenance, Rehabilitation and Feedback Systems, Example~ of HDM andRTIM Packages, Highway Financing, Fund Generation, Evaluating Alternate Strategies and Decision Criteria.

PAVEMENT INVENTORIES AND EVALUATION:
Serviceability Concepts, Visual Rating, Pavement Serviceability Index, Roughness Measurements, Distress Modes - Cracking, Rutting etc, Pavement Deflection – Different Methods, Skid Resistance, Roughness, Safety Aspects. Inventory System - Assessment of Deficiencies.

UNIT-II PAVEMENT MAINTENANCE AND QUALITY CONTROL:
Causes of Deterioration, Traffic and Environmental Factors, Pavement Performance Modelling Approaches and Methods, Methods of Maintaining WBM, Bitumen and Cement Concrete Roads, Quality Assurance / Quality Control - ISO 9000; Sampling Techniques Tolerances and Controls Related to Profile and Compaction.

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

UNIT-IV BITUMINOUS PAVEMENT CONSTRUCTION:
Preparation and Laying of Tack Coat, Bituminous Macadam, Penetration Macadam, Built up Spray Grout, Open Graded Premix, Mix Seal, Semi-dense, Asphalt Concrete ¬InterfaceTreatments and Overlay Construction, IRC Specifications, Introducing Mechanical Mixers, Pavers, Finishers.

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

PAVEMENT LIFE CYCLE COST ANALYSIS:
Cost Components, Methods of LCA - Brief Description - Items Considered - Case Studies PAVEMENT MAINTENANCE MANAGEMENT:Components of Maintenance Management and Related Activities - Network and Project Level Analysis - Budgeting - Prioritisation Techniques and Formulation of Maintenance Strategies.

TEXT BOOKS:
1.Haas and Hudson, W.R. Pavement Management Systems - McGraw Hill

2. Sargious, M.A. - Pavements and Surfacing for Highways and Airports - Applied Science Publishers Ltd.

3.Bridge and Pavement Maintenance - Transportation Research Record No.BOO, TRB

4.Shahin MY,1994 - Pavement Management for Airports, Roads and parking Lots.

5.Bent Thagesan, 1996 - Highway and Traffic Engineering for Developing Countries.

Code: 21 CE 304

Remote Sensing and Geographic Information System
L-T-P-S : 3-0-0-0

UNIT-I

Basic concepts of GIS & GPS, introduction to remote sensing, remote sensing system, electromagnetic spectrum, black body, atmospheric windows, spectral characteristics of earth's surface, range of sensing system.

GPS: Basic concepts, components, factors affecting, GPS setup, accessories, segments- satellites & receivers, GPS applications, Case studies

UNIT-II

Platforms, Sensors and Data Products:

Ground aircraft, Spacecraft platforms, photographic sensors, scanners, radiometers, radar and mission planning, data types and format, scale and legend.

Interpretation and Analysis Techniques:

Multispectral, multitemporal, multisensoral, multistage concepts, photo interpretation techniques for aerial photo and satellite imagery, interpretation elements, false colour composition, etc.

UNIT-III

Photogrammetry: Photogrammetry- Basic application, applications of aerial photo interpretation to water resources engineering.

Digital Analysis: Preprocessing and processing, image restoration/enhancement procedures, pattern recognition concepts, classification algorithms, post processing procedures.

UNIT-IV

Structure of GIS:

Cartography, Geographic mapping process, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, database management systems, Raster data representation, Vector data representation, Assessment of data quality, Managing data errors, Geographic data standards.

GIS Data Processing, Analysis and Modeling: Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts, and nearest neighbour analysis – Network analysis – Surface modeling – DTM.

UNIT-V

Application in Civil Engineering:

River drainage and flood flow, watershed delineation and characteristic studies, command area mapping, drought assessment, groundwater inventory, soil moisture study, water quality assessment and monitoring, Land use data acquisition, disaster management.

TEXT BOOKS:

1. Thomas, M. Lillisandand R.W.Kiefer; Remote Sensing and Image Interpretation, John Wiley, 1987.

2. Sabins and Floyd, F.J.R; Remote Sensing Principles and Interpretation, W.H. Freeman, Sanfrancisco, 1978.

3. C. Elachi; Introduction to Physics and Techniques of Remote Sensing, New York Wiley, 1987.

4. Phillip, H. Swain and Shirley, M. Davis; Remote Sensing- The Quantitative Approach, McGraw Hill Publications , 1978.

5. Johnson, R. Jenson; Introductory Digital Image Processing, Prentice hall , 1986.

6. Ian Heywood, S. Cornelius and S. Carver, An Introduction to Geographical Information Systems, Pub. By Pearson Education (Singapore) Pvt. Ltd., Printed in Replica Press Pvt. Ltd., India, 2001

7. Agarwal, N. K., Essentials of GPS, Spatial Networks Pvt. Ltd., Hyderabad, 2004

Code: 21 CE 204

STRUCTURAL DYNAMICS
L-T-P-S : 3-0-0-0

UNIT-1

Equation of Motions:

Problem Statement, Solution Methods of Single Degree of Freedom Systems (SDOF): Basic concepts of structural dynamics; single degree of freedom system, force displacement relationship, damping force, equation of motion, mass-spring-damper system, methods of solution of differential equation. Free Vibration (SDoF): Undamped free vibration, viscously damped free vibration, energy in free vibration. Response to Harmonic and Periodic Excitations (SDoF): Response to vibration generator, natural frequency and damping from harmonic test, force transmission and vibration isolation, vibration measuring instruments, energy dissipated in viscous damping.

UNIT-2

Response to Arbitrary, Step and Pulse Excitations (SDoF):

Response to unit impulse, response to arbitrary force, step force, ramp force, response to pulse excitations, solution methods, effects of viscous damping. Numerical Evaluation of Dynamic Response (SDoF): Time stepping methods, methods based on interpolation of excitation, central difference method, Newmark's method, stability and computational error, analysis of nonlinear response by Newmark's method.

UNIT-3

Earthquake Response to Linear Systems (SDoF)

Earthquake excitation, equation of motion, response quantities, response history, response spectrum concept, deformation, pseudo-velocity and pseudo acceleration response spectra, peak structural response from the response spectrum, response spectrum characteristics, elastic design spectrum, comparison and distinction between design and response spectra.

UNIT-4

Multi -degree of freedom systems (MDoF): Equation of motions: simple system-two storey shear building, general approach for linear systems, static condensation, and symmetric plan systems: ground motion. Multiple support excitation, methods of solving the equation of motions. Free Vibration (MDoF): Natural frequencies and modes: systems without damping, modal and spectral matrices, orthogonality of modes, normalization of modes. Solution of undamped free vibration systems, solution methods for eigenvalue problem.

Text Books:

1. Basics of Structural Dynamics & Aseismic Design by Damodarasamy S. R., kavitha S., PHI Learning Pvt. Ltd. 5th Edition 2009
2. Dynamics of Structures by R.W. Clough and P.E. Penzien, McGraw-Hill. 1st edition 1975

Reference books:

1. Dynamics of structures by Anil K Chopra; Prentice-Hall of India Limited, New Delhi.3rd edition 2006
2. Structural Dynamics for Structural Engineers by G. C. Hart & K. Wang; John Wiley & Sons. 1st edition 1991
3. Structural Dynamics by Mario Paz, CBS Publishers, 1st edition 1991.

Code: 21 CE 305

SURFACES HYDROLOGIC SYSTEMS
L-T-P-S : 3-0-0-0

Unit – 1
Introduction, Properties of water, Uses of water, New Terms, Hydrological cycle. Hydrological processes,Systems concept and approach, Applications of Hydrology. Field data needed in Hydrology, Precipitation Processes, Factors affecting precipitation processes, Precipitation measurements, Supplementing rainfall record, Precipitation Relationships: a) Spatial and temporal variations, b) Area-Duration (AD), c) Intensity-Duration (ID), d) Intensity-Duration-Frequency (IDF), e) Depth-Area-Duration (DAD), Methods of data presentation, Thiesen Polygon and Isopluvial Maps, Development of relationships from daily data, Probable Maximum Precipitation (PMP)

Unit -2
Statistical parameters, Probability distribution, Frequency analysis,.Regression and correlation, Multivariate linear regression and correlation,Analysis of time seriesInfiltration, Measurement of Infiltration, Richard's equation, Green – Ampt model, Soil Conservation Service(SCS) model, Ponding time, Evaporation – process description, Evaporation measurement and estimation,Modified Penman equation, Evapotranspiration

Unit – 3
Rainfall – runoff analysis, Surface Runoff, Methods of measuring surface runoff, Hortonian and Saturation overland flow mechanisms, Drainage basin characteristics, Stream flow hydrograph, Excess (effective) rainfall and Direct runoff, Abstractions using infiltration techniques, SCS method of abstractions, Flow depth, velocity and travel time.derivation of S hydrograph.

Unit – 4
Hydrograph analysis, Phi-index and Corps of Engineers procedure, Unit hydrograph (UH) theory, UHderivation, Instantaneous UH, Synthetic unit hydrograph, Unit hydrographs of different rainfall durations.

Unit – 5
Hydrologic flood routing, Lumped system routing, Level pool routing, Runge – Kutta method, Goodrich Method, Muskingum Method, Muskingum-Cunge method, Hydrological river routing, Modified Pul's Method, Linear reservoir model, Saint – Venant equations, Classification of distributed routing models, Introduction to Hydrological Numerical Models, HEC – 1

TEXT BOOKS:

2. Chow V.T., Maidment D.R. and Mays L.W. "Applied hydrology", McGraw Hill Inc. New York.
3. K. Subramanya, "Engineering Hydrology", Tata McGraw Hill Publishing Company, Ltd., New Delhi
4. Singh V.P. "Hydrologic Systems", Prentice Hall Inc. New York
5. Viessman W., Lewis G.L. and Kanpp J.W. "Introduction to hydrology", Harper & Row Publications Inc., Singapore
6. Ponce W.F. "Engineering Hydrology", Prentice Hall Inc. New York

REFERENCES:

Following problems have to be solved using MS-EXCEL

1. Analysis of discrete and continuous hydrologic data
2. Frequency analysis
3. Regression, correlation and multivariate analysis
4. Analysis and modeling of Time series
5. Probabilistic treatment of hydrologic data
6. Determination of yield from a catchment – A case study
7. Derivation of Unit hydrograph from single and multi-storm events
8. Estimation of probable maximum flood and design flood – A case study
9. Hydrologic and Hydraulic flood routing methods applied to Indian rivers
10. Derivation of Synthetic Unit Hydrograph – A case study
11. Analysis of distribution networks

Code: 21 CE 303

ADVANCED STRUCTURAL MECHANICS

L-T-P-S : 3-0-0-0

UNIT 1

Two-dimensional problems in rectangular coordinates

Plane stress; Plane strain; Differential equations of equilibrium; Boundary conditions; Compatibility equations; Stress function; Governing differential equation; Solution by Polynomials; End effects – Saint-Venant's Principle; Determination of displacements; Bending of a cantilever loaded at the end; Bending of a beam by uniform load

UNIT 2

wo-dimensional problems in polar coordinates

General equations in polar coordinates; Stress distribution symmetrical about an axis; Effect of circular holes on stress distribution in plates; Concentrated force at a point of a straight boundary; Concentrated force acting on a beam; Stresses in a circular disc, general solutions of the two-dimensional problem in polar coordinates, applications of the general solutions in polar coordinates.

UNIT 3

Analysis of stress and strain in three dimensions

Stress at a point – components of stress; Principal stresses; Stress ellipsoid and stress director surface; Determination of principal stresses; Stress invariants; Determination of maximum shear stresses; Octahedral shear stress; strain at a point – Components of strain; differential equations of equilibrium, the principle of superposition

UNIT 4

Strain Energy Methods

Total strain energy; Principle of virtual work; Griffith's theory of rupture; Castigliano's theorem; Principle of least work (Stationary potential energy), applications of the principle of least work rectangular plates, shear lag.

UNIT 5

Torsion: Torsion of straight bars – Saint Venant's theory; Elliptic cross section; Membrane analogy; Torsion of a bar of narrow rectangular cross-section; Torsion of rolled profile sections; Torsion of thin tubes**. Plasticity:** Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

TEXT BOOKS:

1. Advanced Mechanics of Solids, Srinath L.S., Tata McGraw Hill,2000.
2. Theory of Elasticity, Timoshenko S. and Goodier J. N., McGraw Hill, 1961.
3. Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill,1994.
4. Theory of Elasticity, Sadhu Singh, Khanna Publishers, 2003.

REFERENCE BOOKS:

1. Elasticity, Sadd M.H., Elsevier, 2005.
2. Engineering Solid Mechanics, Ragab A.R., Bayoumi S.E., CRC Press,1999.
3. Computational Elasticity, Ameen M., Narosa, 2005UNIT-V

Code: 21 CE 210

TRAFFIC ENGINEERING
L-T-P-S : 3-0-0-0

UNIT-I.TRAFFIC CHARACTERISTICS:

Basic traffic characteristics - Speed, volume and concentration. Relationship between Flow, Speed and Concentration TRAFFIC MEASUREMENT AND ANALYSIS:Volume Studies - Objectives, Methods; Speed studies - Objectives: Definition of Spot Speed, time mean speed and space mean speed; Methods of conducting speed studies;

UNIT-II SPEED STUDIES:

Methods of conducting speed studies; Presentation of speed study data; Head ways and Gaps; Critical Gap; Gap acceptance studies. HIGHWAY CAPACITY AND LEVEL OF SERVICE:Basic definitions related to capacity; Level of service concept; Factors affecting capacity and level of service; Computation of capacity and level of service for two lane highways Multilane highways and free ways.

UNIT-III PARKING STUDIES AND ANALYSIS:

Types of parking facilities - on street parking and off street Parking facilities; Parking studies and analysis.

UNIT-IV TRAFFIC SAFETY:

Accident studies and analysis; Causes of accidents - The Road, The vehicle, The road user and the Environment; Engineering, Enforcement and Education measures for the prevention of accidents.

UNIT- V TRAFFIC CONTROL AND REGULATION:

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

TRAFFIC AND ENVIRONMENT:

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

REFERENCES:

1. Traffic Engineering and Transportation Planning - L.R. Kadiyali, Khanna Publishers.
2. Traffic Engineering - Theory & Practice - Louis J. Pignataro, Prentice Hall Publication.
3. Principles of Highways Engineering and Traffic Analysis - Fred Mannering & Walter P. Kilareski, John Wiley & 50ns Publication.
4. Transportation Engineering - An introduction - C. Jotin Khistry, Prentice Hall Publication.
5. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.

Code: 21 CE 206

WATER QUALITY AND ENVIRONMENT
L-T-P-S : 3-0-0-0

UNIT-I
Introduction:

The composition and characteristics of natural waters. Effect of Temperature, Equilibria in water systems. **Water Quality Characteristics :** Physical, Chemical and Biological Characteristics of Water. Standard methods of determination of important physical and chemical parameters of water quality, eg. PH, turbidity, electrical conductivity, total Solids, alkalinity, hardness etc., Units of measurements and expression of results, Bacteriological Indicators, and determination of Coliforms.

UNIT-II
Instrumental Methods of Chemical Analysis:
Concepts of Instrumental/ Analysis on Selective Electordes, Atomic Absorption spectrophotometric methods, potentiometry including electrodes, Gas chromatography. 2 o **Concepts in Organic and Biochemical Methods:** Biochemical cycles of C, N, P and S, Trace Organics, Detergents, Pesticides, Fertilisers , etc. **Water Quality Representation and Standards:**
Water Quality Criteria, Guidelines, and Standards for Various uses.

UNIT-III Water
Pollution
Natural factors affecting water quality and pollution from various wastes , mechanisms of surface water pollution, point and Non-point sources , Effect of Geological formations on Water quality.

UNIT-IV
Water Quality in Receiving Water Bodies: Lakes and Impoundments , Stratification and Eutrophication , Water Quality in Rivers , self purification and Reaeration , Dissolved Oxygen Balance in Rivers , Thermal Pollutions.

UNIT-V
Ground Water Quality: Sources and Mechanisms of Groundwater Pollution. Groundwater Pollution from Lnadfills and Waste Dumps. **Case Studies:** Case Studies on Environmental Impact of Dam and Irrigation Schemes ,
and Land Reclamation Projects.

TEXT BOOKS:
Metcalf And Edduy, Inc.; Waste Water Engineering, Treatment, Disposal, Reuse, Tata McGraw Hill.
Masters G.M.; Introduction to Environmental Engineering and Science, Pretice hall of India, 1994.
Garg, S.K.” Water Supply Engineering”, Vol.1, Khanna Publishers,New Delhi,2003.

Code: 21 CE 307

WATERSHED AND WETLAND MANAGEMENT
L-T-P-S : 3-0-0-0

UNIT-1: Fundamentals: Fundamentals of Remotesensing &GIS, Internal Constitution of the Earth. Basic Concepts of Geologic Structures Governing Occurrence and Movement of Ground Water, Ground Water in Igneous, Metamorphic and Sedimentary Rocks, Hydrogeological Methods of Exploration

UNIT-2: Watershed Management:

Objectives of Planning Watershed Projects, Guidelines for Project Preparation, Watershed Delineation, Codification, Resources Surveys, Hydrological, Soil, Vegetative and Land Use Surveys, Socio-Economic Surveys, Water and Soil Conservation Works, People's Participation and Constraints, Participatory Rural Appraisal in Watershed Programme, Community Mobilization & Participatory Management, Peoples Institutions, Capacity Building.

UNIT-3: **Rain Water-Harvesting Methods:**

Methods of Rainwater Harvesting from Roof Tops, Purification Techniques for Direct use, Harvesting of Surface Runoff, Climatic Changes, Its Effects on Water Resourc

UNIT-4: Wetlands:

Introduction, Definition, Classification, Delineation, Identification Methods, Importance Of Wetlands, Human Impacts, Wetland Protection, Mitigation. Wetland Management: Designed Ecosystem, Water and Treated Wastewater Recycling and Reuse, Soil Filters, Constructed Wetlands Ecosystem & Water Supplies.

UNIT-5: WATER RESOURCES APPLICATIONS: Preparation of Water Resources Action plan, Preparation of Ground water prospects map, Preparation of Ground water potential zones, Preparation of Ground water quality mapping, Idetification of salt water intrusion zones.

TEXT BOOKS:

1. Hydrogeology by Davis and Dewiest
2. Soil and Water Conservation Engineering by Schwarb, Fengmin, John Wiley, 2002.
3. Applied Hydrology by Ven Te Chow, Maidenment & Mays, Mc Graw Hill, 1987.
4. Water Resources Engineering by L.W.Mays, Wiley, 2004.

REFERENCE BOOKS:

1. Watershed Management for Indian conditions by E.M. Tademan, Omega Scientific Publishers, 2002.
2. Watershed Hydrology by Peter.S.Black, Prentice Hall, 1991.
3. Manual on Water Supply and Treatment, 3rd Edition- Revised & Updated, May, 1999 Published by CPHEEO, Ministry of Urban Development, GOI, New Delhi.
4. Analysis of flow in water distribution Networks by P.R. Bhave, Technomic Publishing Co., USA, 1991.
5. Geiger, W.F., Marsalek, J. Zudima and Rawls, G. J. (1987 "Manual on Drainage in Urban Areas", 2 Volumes, UNESCO, Paris.
6. Storm water Management by Wanelista and Edelin, Wiley publications, 1993.