# CHAITANYA (DEEMED TO BE UNIVERSITY) WARANGAL

Course Structure and Syllabus for Pre Ph.D

# CIVIL ENGINEERING (2020-2021)

## PAPER – I: RESEARCH METHODOLGY

**(Common for all Specializations) PART-A**

**Unit-I: Research Design & Ethics**

1. **Objectives and types of research**: Motivation in research. Approaches and significance of research. Research and scientific methods. Selecting the problem. Technique involved in defining a problem (hypothesis). Interpretation and report writing. Significance of report writing. Different steps in writing report. Stages of writing. Designing illustrations, tables, figures, general guidelines for illustrations. Oral presentation. Citation methods. Impact factor.
2. **Research Ethics**: Ethics in research. Misconduct and consequences. Forms and consequences of plagiarism. Intellectual property rights. Copy right regulations and patents.

## Unit-II: ICT in Research and Data Analysis

1. **Use of ICT for research purposes** – Internet and web-based resources. Search engines. Advanced search techniques. Use of web as a tool for scientific literature survey.
2. **Data Analysis –** Types of errors. Accuracy and Precision. Least square analysis, average and standard deviations. Correlation and Regression analysi**s.** Methods of least squares. Regression versus correlation. Correlation versus determination. Types of correlation and their specific applications.

**PART-B**

**Unit-III: Infrared and Electronic Spectroscopy**

1. **Infrared Spectroscopy:** Vibrational energy of diatomic molecules. Anharmonic oscillator. Selection rules, Overtones, Hot bands, Zero point energy. Calculation of force constant of diatomic molecules. Rotational—Vibrational spectra, P, Q, R-branches. Instrumentation. Sampling techniques. Functional group frequencies. Factors influencing vibrational frequencies, Coupled vibrations, Fermi resonance, Combination bands. Applications of IR Spectroscopy in structure elucidation of organic molecules; cis-trans isomers, keto-enol tautomers, hydrogen bonding. IR spectra of metal coordinated NO3-, SO42- and CO32- ions
2. **Electronic Spectroscopy:** Electronic spectra: Elementary energy levels of molecules-selection rules for electronic spectra; types of electronic transitions in molecules. Chromophores: Congugated dienes, trienes and polyenes, unsaturated carbonyl compounds, Benzene, mono substituted derivative (Ph-R), di substituted derivative (R-C6H4-Rʹ) and substituted benzene derivatives (R-C6H4-CORʹ), Woodward-Fieser rules. Polynuclear aromatic compounds (Biphenyl, stilbene, naphthalene, anthracene, phenanthrene and pyrene). Heterocyclic systems. Absorption spectra of charge transfer complexes. Solvent and structural influences on absorption maxima, stereochemical factors. Cis-trans isomers, and cross conjugation. Beer’s law application to mixture analysis and dissociation constant of a weak acid.

## Unit-IV: 1H and 13C NMR spectroscopy

* 1. **1H NMR spectroscopy:** Magnetic properties of nuclei, Principles of NMR Instrumentation, CW and pulsed FT instrumentation, equivalent and non-equivalent protons, enantiotopic and diastereotopic protons, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin- spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting

coupling constants. Applications of 1H NMR spectroscopy: Reaction mechanisms (cyclic bromonium ion, electrophilic and nucleophilic substitutions, carbocations and carbanions), E, Z isomers, conformation of cyclohexane and decalins, keto-enol tautomerism, hydrogen bonding, proton exchange processes (alcohols, amines and carboxylic acids), C-N rotation. Types of 1H NMR First order and non-first order spectra e.g., AX, AX2, AX3, A2X3, AMX and AB, ABC. Simplification of complex spectra: increased field strength, Lanthanide shift reagents and double resonance techniques. Nuclear Overhauser enhancement (NOE) and its applications.

* 1. **13C NMR (CMR) Spectroscopy:** Equivalent and non-equivalent carbons, enantiotopic and diastereotopic carbons, Types of CMR spectra, Chemical shifts and coupling in CMR. Factors effecting on Chemical shifts and coupling constants.

## Unit-V : Mass Spectrometry:

Origin of mass spectrum, principles of EI mass spectrometer. Types of fragments: odd electron and even electron containing neutral and charged species (even electron rule), Nitrogen rule, isotopic peaks, determination of molecular formula, metastable ion peaks. High resolution mass spectrometry. Salient features of fragmentation pattern of organic compounds including β-cleavage, Mclafferty rearrangement, retro Diels – Alder fragmentation and ortho effect. Principle of EI, CI, Fast Atom Bombardment (FAB), Secondary Ion Mass Spectrometry (SIMS), Electrospray (ESI) ionization method.

## References:

1. Research Methodology: Methods and techniques - C. R. Kothari, 2nd Edn, (New Age International Publishers).
2. Research methodology and statistical tools – P. Narayana Reddy and G. V. R. K. Acharyulu. Ist Edn, (Excel books, New Delhi, 2008).
3. Statistical Methods – S. P. Gupta. (S. Chand & Sons, New Delhi, 2005).
4. R. Ganeshan. Research Methodolgy for Engineers (MJP Publications, 2011).
5. Principles of Instrumental analysis, 5th edition. Skoog (Hollar and Nieman Harcourt, Asia).
6. Vogel’s text book of quantitative chemical analysis 6th Edn. Mendham, Denney, Barnes and Thomas. Low Price edition.
7. Spectroscopy of organic compounds – P. S. Kalsi (New Age International).
8. Organic spectroscopy – Jag Mohan (Narosa Publishers)
9. Elementary Organic Spectroscopy – Y. R. Sharma (S. Chand & Company).
10. Molecular Spectroscopy – William Kemp (ELBS).
11. Applications of Spectroscopy – J. Dyer
12. Fundamentals of Molecular Spectroscopy – Banwell & M C Cash (Tata Mc Graw Hill)

## PAPER – II

Choose any **one** subject of the following

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| --- | --- | --- |
| **S.NO** | **PAPER** | **PAPER CODE** |
| **1** | Advanced Foundation Engineering | **20PH05101** |
| **2** | Advanced Modeling Techniques in Highway Engineering | **20PH05102** |
| **3** | Advanced Structural Analysis | **20PH05103** |
| **4** | Advanced Travel Demand Modelling | **20PH05104** |
| **5** | GIS Applications in Transportation Engineering | **20PH05105** |
| **6** | Advanced Concrete Technology | **20PH05106** |
| **7** | Structural Dynamics | **20PH05107** |
| **8** | Experimental Stress Analysis | **20PH05108** |
| **9** | Finite Element Methods | **20PH05109** |
| **10** | Urban Transportation Planning | **20PH05110** |
| **11** | Geosyntecis and Soil Reinforcement | **20PH05111** |
| **12** | Pavement Construction, Maintenance & Management | **20PH05112** |
| **13** | Water Resources System and Analysis | **20PH05113** |
| **14** | Advanced Hydrologic Analysis | **20PH05114** |
| **15** | Ground Water Modeling | **20PH05115** |
| **16** | Design of Water & Waste Water Systems | **20PH05116** |
| **17** | Physico-Chemical Processes for Water Quality Control | **20PH05117** |
| **18** | Soil Dynamics Machines Foundations | **20PH05118** |
| **19** | Earthquake Resistant Design of Buildings | **20PH05119** |
| **20** | Environmental Impact Assessment for Transportation Projects | **20PH05120** |

# CHAITANYA (DEEMED TO BE UNIVERSITY) WARANGAL

***Subject Code*** :20PH05101

**ADVANCED FOUNDATION ENGINEERING**

1. **Soil Exploration**: Exploration Methods; Planning the Exploration Program; Boring and Sampling; In Situ Tests: Standard & Cone Penetration Tests, Field Vane & Borehole shear tests, Dilatometer, Pressuremeter; Rock Sampling, Core Recovery, RQD; Geophysical Exploration; Preparation of Soil Report.
2. **Shallow Foundations**: **Bearing Capacity:**- General Formulae; Effect of Water Table; Footings with Eccentric or Inclined Loads, on Layered Soils, on slope and on top of the slopes, on finite layer with a Rigid Base at Shallow Depth, effect of compressibility of soil, on soils with strength increasing with depth.
3. **Settlement**: Components – Immediate, Consolidation & Creep, Stresses and Displacements in Homogeneous, Layered and Anisotropic Soils; Consolidation Settlement; One, Two & Three Dimensional Consolidation; Secondary Compression Settlement; Bearing Pressure using SPT, CPT, Dilatometer and Pressuremeter; Settlement of foundations on Sands-Schmertmann and Burland & Busbridge methods; Structure Tolerance to Settlement and Differential Settlements, Rotation of Tall Structures.
4. **Deep Foundations**: **Single Pile:** Vertically loaded piles, Static capacity-

□□and□Methods, Dynamic formulae; Wave Equation Analyses; Point Bearing Resistance with SPT and CPT Results; Bearing Resistance of Piles on Rock; Settlement; Pile Load Test; Uplift Resistance; Laterally Loaded Piles -Ultimate Lateral Resistance; Negative Skin Friction; Batter Piles; Under Reamed Piles; Mini and Micro Piles, Buckling of Fully and Partially Embedded Piles; Ultimate Capacity of Pile Groups in Compression, Pullout & Lateral Load; Efficiency; Settlements of Pile Groups; Interaction of Axially & Laterally Loaded Pile Groups.

# Soil-Foundation-Structure Interaction

Contact pressures and soil-structure interaction for shallow foundations; Concept of subgrade modulus; effects/parameters influencing subgrade modulus; Analysis of foundations of finite rigidity; Beams on elastic foundations; Analysis of raft foundations; Compensated Foundations.

# Reference:

1. Das, B. M. - Principles of Foundation Engineering 5th Edition
2. Bowles, J. E. - Foundation Analysis & Design 5th Edition
3. Poulos, H. G. & Davis, E. H. - Pile Foundation Analysis and Design
4. Reese, L. C. & Van Impe, W. F. - Single Piles and Pile Groups under Lateral Loading
5. Rowe, R. K. - Geotechnical & Geoenvironmental Engineering Hand Book
6. Tomlinson, M. J. - Foundation Design and Construction
7. Reese, L. C. & Wang, S. T. - Analysis and Design of Shallow and Deep Foundations
8. Salgado, R. - The Engineering of Foundations

***Subject Code :20PH05102***

**ADVANCED MODELING TECHNIQUES IN HIGHWAY ENGINEERING UNIT-I**

Introduction to Artificial Intelligence (AI), Significance of AI in Transportation Engineering and uses of AI for solution of Transportation Engineering problems. Comparison between statistical methods and various AI techniques.

# UNIT-II

Fuzzy-logic: Introduction to Fuzzy-logic, merits and limitations of Fuzzy-logic, crisp sets: types and properties of crisp sets, Partition and covering, Fuzzy sets: membership function, basic fuzzy set operations, Fuzzy Relations, Fuzzy Logic applications in Highway Engineering.

# UNIT-III

Artificial Neural Networks (ANN): Introduction to Artificial Neural Networks (ANN), merits and limitations of ANN, Model of an Artificial Neuron, Neural Network Architectures: Single layer, Multi-layer feed-forward and Recurrent Networks, Learning methods (in Brief), Back-propagation Technique: Single and multi layer feed-forward Neural Network, Backpropagation learning, Computations of Input, hidden and output layers, Calculation of error, Training of Neural Network, method of steepest descent and applications of Back-propagation Learning Algorithm in Highway Engineering.

# UNIT-IV

Genetic Algorithms (GA): Basic concepts of Genetic Algorithms (GA), Working Principle, types of Encoding, cross-over, Fitness function, Methods of Reproduction (in brief) and Applications of GA in Highway Engineering.

# UNIT-V

Expert Systems (ES): Introduction to Expert Systems (ES), basic concepts of ES and their Applications in Highway Engineering.

# References :

* 1. Neural Networks, Fuzzy Logic and genetic Algorithms, Synthesis and Applications, by S. Rajasekaran and G. A. Vijayalakshmi Pai, Prentice hall of India Pvt. Ltd. New Delhi, 2003.
  2. Fuzzy Logic With Engineering Applications, Timothy J. Ross, Mcgraw-Hill, 1995.
  3. Artificial Intelligence in Business-Expert System, Harmon P and D. King, John Willey & Sons
  4. Relevant IRC and TRB publications.

***Subject Code: 20PH05103***

**ADVANCED STRUCTURAL ANALYSIS**

**UNIT I**

Introduction to matrix methods of analysis - statically indeterminacy and kinematics indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and tensional element.

Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

# UNIT II

Assembly of stiffness matrix from element stiffness matrix - direct stiffness method - general procedure - bank matrix - semi bandwidth - computer algorithm for assembly by direct stiffness matrix method.

# UNIT III

Analysis of plane truss - continuous beam - plane frame and grids by flexibility methods.

# UNIT IV

Analysis of plane truss - continuous beam - plane frame and grids by stiffness methods.

**UNIT V.** Special analysis procedures - static condensation and sub structuring - initial and thermal stresses.

Shear walls- Necessity - structural behaviour of large frames with and without shear walls - approximate methods of analysis of shear walls.

# REFERENCES

1. Matrix Analysis of Frames structures by William Weaver J.R and James M.Geve, CBS publications.
2. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.
3. Structural Analysis by C.S.Reddy.
4. Matrix Structural Analysis by Kanchi.
5. Matrix Methods of Structural Analysis by J.Meek.
6. Structural Analysis by Ghali and Neyveli.

***Subject Code: 20PH05104***

**ADVANCED TRAVEL DEMAND MODELLING**

**UNIT-I: Qualitaive Variables:** Role of Soft variables in Travel Demand Forecasting; Attitudes; Psychometric scaling Techniques – One-dimensional Scaling – Multidimensional Scaling; Basic Rating Scales: Comparative Rating Scales, Non – Comparative Rating scale, Itemised rating scale, graphic rating scale; Specific Attitude scales; Successive Categories; Principal Components Factor Analysis; Attitudinal Models.

**UNIT-II: Discrete Choice Analysis:** Utility Concept; Mode choice; Logit Models; Dogit Model; Nested Logit Model; Probit Model; Route Choice Modelling; Combined Travel Demand Modelling; Model Parameter Estimation – Maximum Likelihood and Maximum Entropy Estimates.

**UNIT-III: Stated Preference Methods and Time Use Analysis**: Stated preference vs. Revealed Preferences; Design Issues; Survey Methods, Conjoint Analysis; Functional Measurement; Trade off Analysis, Transfer Price Method Time Use Analysis - Activity patterns; Activity scheduling; Activity Time Allocation studies; Activity Episode Analysis; Travel Duration Analysis

**UNIT-IV: Model Aggregation And Transport Demand Models:** Aggregation bias and forecasting; Aggregation Methods; Temporal Stability and geographical stability of Models; Transfer Model Updating Procedures – Transferring with Aggregate and Disaggregate sample data; Transferability Measures. Simplified Transport Demand Models - Sketch planning Methods; Incremental Demand Models; Model estimation from traffic Counts; IVF Models, Marginal and Corridor Models; Gaming Simulation, Quick Response Techniques

**UNIT-V: Advanced Modelling Techniques – I & II:** GO Models; Entropy Models; Equilibrium Assignment Techniques, Multipath Assignment – Dial’s Algorithm, Advanced Modelling Techniques – II - Knowledge Based Expert System; Neuro – Fuzzy Application; ANN Techniques; Genetic Algorithms; Object Oriented Programming; Decision Support Systems; Goal Programming

**REFERENCES:**

1. Orterzar, J. de D. and L.G. Willumasen. Modelling Transport, Wiley Publishers
2. Oppenheim N. Urban Travel Demand Modelling: From Individual Choices to general Equilibrium. John Wiley & sons, Inc
3. Time use Analysis, Special Issue, Transportation, 26, Kluwer Academic Publishers
4. Michael Florian, Economics & Mathematical Systems: Traffic Equilibrium Methods.
5. Wilson A.G., J.D. Coelho, Sm. Macgill and HCWL Williams. Optimisation in Location and Transport Analysis, John Wiley & Sons
6. Ben Akiva, Discrete Choice Analysis: Theory and Application to Travel Demand, MIT Press

***Subject Code: 20PH05105***

**GIS APPLICATIONS IN TRANSPORTATION ENGINEERING**

**UNIT-I: Introduction to GIS and Data Input & Output:**

Introduction, GIS over view, use of GIS in decision making, Data processing, Components of GIS, The GIS and the organization. Data Input and Output - Data input - Key board entry, Manual digitizing, Scanning, Remotely and sensed data, existing digital data, census related data sets, Data output - Hard copy and soft, copy devices.

# UNIT-II: Data Quality and Management :

Components of data quality - Micro level, Macro level components, Sources of error, A note about data accuracy. Data Management - The data base approach, 3 classic data models, Nature of geographic data, Spatial data models, Databases for GIS.

# UNIT-III: GIS Analysis and Functions:

Organizing geographic data for analysis, Maintenance and analysis of the spatial data and non-spatial attribute data and its integration output formatting.

# UNIT-IV: Implementing a GIS:

Awareness, Developing system requirements, Evaluation of alternative systems, System justification and Development of an implementation plan, System acquisition and start up, Operation of the system.

# UNIT-V: Application of GIS in Transportation Engineering – I & II :

Intelligent information system for road accessibility study, GIS data base design for physical facility planning, Decision support systems for land use planning. Application of GIS in Transportation Engineering – II - GIS applications in environment impact assessment, GIS based Highway alignment, GIS based road network planning, GIS based traffic congestion analysis and accident investigation.

**REFERENCES:**

1. GIS for Urban & Regional Planning, Scholten & Stillwen 1990, Kulwer Academie Publisher.
2. GIS A Management, Perspenfi Stan Aronoff, WDL Publisher.
3. GIS By Stonffer

***Subject Code: 20PH05106***

**ADVANCED CONCRETE TECHNOLOGY**

**UNIT - I**

**Cement:** chemical composition – Bogues compounds – heat of hydration – influence of compound composition on properties of cement – Admixtures – minal and chemical admixtures – disage – admixtures of RMC & HCC – latest generation admixture.

**Admixtures:** Classification of aggregate – particle shape and texture – gradation – fineness modules – grading curves. Gap graded aggregates – combined grading – alkali aggregate reaction – soundness of aggregate.

# UNIT – II

Fresh Concrete: workability - factors affecting workability - measurement of workability

- effect of time and temperature on work - segregation and bleeding, Mixing of setting times of concrete – steps in manufacture of concrete. Curing of concrete – Abram’s law – Gel / space ratio – maturity concept – effective water in mix.

# UNIT - III

Hardness Concrete : Strength in compression and tension – Testing of hardness concrete

– modulus of elastics, shrinkage and creep of concrete – Rehology of creep – Non destructive and semi destructive testing of concrete – Durability of concrete.

# UNIT – IV

Quality control of concrete – Quality assurance quality management and quality audit – statistical quality control – Acceptance criteria – codal provisions

Concrete mix design : Design of mixes by BIS method, ACI method, DOS method – Entroy and Shaklok method.

# UNIT – V

Special Concrete: Light weight concrete mix design – Fiber reinforced concrete – SFRC and GFRC - Self Compacting concrete – polymen concrete – Geo Polymer concrete – high performance concrete – smart concrete.

# TEXT BOOKS:

* 1. Properties of Concrete by A.M.Neville, ELBS publications.
  2. Concrete Technology by A.K. Santhakumar, Oxford Press.
  3. Concrete Technology by M.S.Shetty, S.Chand & Co.

# REFERENCES:

1. Special Structural concretes by Rajat Siddique, Galgotia Publications.
2. Design of Concrete Mixes by N.Krishna Raju, CBS Publications.
3. Concrete: Micro Structure by P.K.Mehta, ICI, C

**STRUCTURAL DYNAMICS Subject code: 20PH05107**

**Theory of vibrations**: Introduction - Elements of vibratory system - Degrees of Freedom

- Continuous System - Lumped mass idealization - Os

cillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. - Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation -Dynamic magnification factor

– Phase angle – Bandwidth

# UNIT II

**Introduction to Structural Dynamics :** Fundamental objectives of dynamic analysis - Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton’s law of motion / D’Alembert’s principle, Principle of virtual work and Hamilton principle.

**Single Degree of Freedom Systems :** Formulation and solution of the equation of motion - Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

# UNIT III

**Multi Degree of Freedom Systems :** Selection of the degrees of Freedom - Evaluation of structural property matrices - Formulation of the MDOF equations of motion - Undamped free vibrations - Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – Normal co-ordinates - Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition procedure.

# UNIT IV

**Practical Vibration Analysis:** Introduction - Stodola method - Fundamental mode analysis - Analysis of second and higher modes - Holzer method - Basic procedure.

**Continuous Systems:** Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

# UNIT V

**Introduction to Earthquake Analysis:** Introduction - Excitation by rigid base translation - Lumped mass approach - SDOF and MDOF systems - I. S. Code methods of analysis for obtaining response of multi storeyed buildings.

# REFERENCES:

1. Dynamics of Structures by Clough & Penzien, McGraw Hill, New york
2. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.
3. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
4. I.S: 1893 - 1984, “Code of practice for Earthquake resistant design of Structures” and latest I.S: 1893 - 2002 (version) Part-1

***Subject Code 20PH05108***

**EXPERIMENTAL STRESS ANALYSIS**

**UNIT I**

Basic equations and Plane Elasticity Theory: Introduction, Strain equations of Transformation, Compatibility, Stress-Strain Relations-Two dimensional State of Stress. The Plane-Elastic problem, The Plane-Strain Approach, Plane Stress, Airy’s Stress function-Cartesian Co-ordinates-Two dimensional problems in Polar Co-ordinates, Polar Components of Stress in terms of Airy’s Stress function, Forms.

Principles of Experimental Approach: Merit of Experimental Analysis introduction, uses of experimental stress analysis-Advantages of experimental stress analysis, Different methods, Simplification of problems.

# UNIT II

Strain Measurement using Strain Gauges: Definition of strain and its relation to Experimental Determinations, properties of strain-gauge systems, Types of strain gauges, Mechanical and Optical strain gauges. Electrical Strain Gauges- Introduction, LVDT - resistance strain gauge - various types - gauge factor, Materials for adhesion base, etc.

Strain Rosettes: Introduction, The three element rectangular Rosette - The delta rosette - Corrections for Transverse strain effects.

# UNIT III

Brittle Coating Method: Introduction, Coating stresses - Failure theories - Brittle coating Crack pattern - Crack detection - Types of Brittle coating - Test procedures for brittle coating analysis - Calibration procedures - Analysis of brittle coating data.

# UNIT IV

Theory of Photo Elasticity: Introduction, Temporary double refraction - The stress optic law - Effects of stressed model in a Polaris cope for various arrangements - Fringe sharpening, Brewster stress optic law.

# UNIT V

Two Dimensional Photo Elasticity: Introduction, Isochromatic Fringe patterns - Isoclinic fringe patterns, passage of light through plane Polaris cope and circular Polaris cope, Isoclinic fringe pattern - Compensation techniques - calibration methods, separation methods, scaling Model to Proto type stress- Materials for photo - elasticity, properties of photo elastic materials.

# REFERENCES :

1. Experimental Stress Analysis by J.W.Dally and W.F.Riley
2. Experimental Stress Analysis by Dr. Sadhu Singh
3. Experimental Stress Analysis by Dove and Adams

***Subject Code 20PH05109***

**FINITE ELEMENT METHODS**

**UNIT I**

Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles

– discrimination - Raleigh - Ritz method of functional approximation.

Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi- symmetric loading.

# UNIT II

One dimensional FEM: Stiffness matrix for beam and bar elements - shape functions foe ID elements.

Two dimensional FEM: Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices

# UNIT III

Isoparametric formulation: Concept - different isoparametric elements for 2D analysis - formulation of 4-noded and 8-noded isoparametric quadrilateral elements - Lagrange elements - serendipity elements.

Axi Symmetric Analysis: bodies of revolution - axi symmetric modeling - strain displacement relationship - formulation of axi symmetric elements.

Three dimensional FEM: Different 3-D elements-strain-displacement relationship – formulation of hexahedral and isoparametric solid element.

# UNIT IV

Introduction to Finite Element Analysis of Plates: basic theory of plate plate bending - thin plate theory - stress resultants - Mindlin's approximations - formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.

# UNIT V

Introduction to non – linear analysis – basic methods – application to Special structures.

# REFERENCES:

1. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons.
2. Finite element Methods by OC Zienkiewicz
3. Finite element analysis, theory and progarmming by GS Krishna Murthy.
4. Introduction to Finite element Method by Tirupathi Chandra Patila and Belugunudu.
5. Introduction to Finite element Method by JN Reddy.

***Subject Code 20PH05110***

**URBAN TRANSPORTATION PLANNING**

**UNIT-I: Urban Transportation Problem Travel Demand:** Urban Issues, Travel Characteristics, Evolution of Planning Process, Supply and Demand – Systems approach. Travel Demand: Trends, Overall Planning process, Long term Vs Short term planning, Demand Function, Independent Variables, Travel Attributes, Assumptions in Demand Estimation, Sequential, and Simultaneous Approaches, Aggregate and Disaggregate Techniques.

**UNIT-II: Data Collection And Inventories:** Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques, Expansion Factors, Accuracy Checks, Use of Secondary Sources, Economic data – Income – Population – Employment – Vehicle Owner Ship.

**UNIT-III: Four Stage Demand Forecasting :** UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates. Trip Distribution: Growth Factor Methods, Gravity Models, Opportunity Models, Time Function Iteration Models.

**UNIT-IV: Mode Choice and Traffic Assignment :** Mode Choice Behaviour, Competing Modes, Mode Split Curves, Models and Probabilistic Approaches. Traffic Assignment: Basic Elements of Transport Networks, Coding, Route Properties, Path Building Criteria, Skimming Tree, All-or-Nothing Assignment, Capacity Restraint Techniques, Reallocation of Assigned Volumes, Equilibrium Assignment, Diversion Curves.

**UNIT-V: Plan Preparation And Evaluation:** Travel Forecasts to Evaluate Alternative Improvements, Impacts of New Development on Transportation Facilities. Master plans, Selection of Corridor, Corridor Identification, Corridor deficiency Analysis

**REFERENCES:**

1. Introduction to Transportation Planning – M.J.Bruton; Hutchinson of London Ltd.
2. Introduction to Urban System Planning - B.G.Hutchinson; Mc Graw Hill.
3. Traffic Engineering and Transport Planning - Kadiyali L.R., Khanna Publishers
4. Lecture notes on UTP - Prof. S. Raghavachari , R.E.C.Warangal.

***Subject Code 20PH05111***

**GEOSYNTHETICS AND SOIL REINFORCEMENT**

* 1. **An Overview of Geosynthetics**: Description of Geosynthetics, Properties, Functions
  2. **Soil Reinforcement:** Mechanism, Reinforced slopes, Embankments on soft ground, Reinforced Embankments, Reinforced soil walls and Slope stabilization.
  3. **Geoenvironmental Applications:** Geomembranes for landfills and ponds, Geosynthetic clay liners, Designing with GCL’s, Filtration, Erosion control, Slope protection.
  4. **Geosynthetics for Highways:** Roadway Reinforcement, Separation, Filtration, Drainage, Reinforcement, Moisture Barrier, Membrane encapsulation.
  5. **Ground Improvement:** Drainage, PVDs, French Drains, etc.

# References:

1. Koerner, R. M. - Designing with Geosynthetics
2. Rao, G. V. & Raju G. V. S. S. - Engineering with Geosynthetics
3. Hausmann, M. R. - Engineering Principles of Ground Modifications
4. Xianthakos, Abremson and Bruce - Ground control and Improvement
5. Mosley - Ground Improvement
6. Jones, C. J. F. P. - Earth Reinforcement and soil structures

***Subject Code 20PH05112***

**PAVEMENT CONSTRUCTION MAINTENANCE AND MANAGEMENT**

**UNIT-I: Pavement Inventories, Evaluation and Management System :**

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. Pavement management system - Components of PMS and their activities;Major steps in implementing PMS; Inputs; Design, Construction and Maintenance; Rehabilitation and Feedback systems; Examples of HDM and RTIM packages; Highway financing; Fund generation; Evaluating alternate strategies and Decision criteria

# UNIT-II: Pavement Maintenance and Quality Control :

Causes of Deterioration, Traffic and Environmental Factors, Pavement Performance Modelling Approaches and 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 Base, Cement Stabilised Sub- Bases, WBM Bases, Wet Mix Construction; Crushed Cement Bases, Shoulder Construction; Drainage Surface, Turfing Sand Drains; Sand Wicks; Rope Drains, Geo- Textile Drainage; Preloading Techniques **UNIT-IV:** Bituminons Pavement Construction and Cement Concrete Pavement Analysis :

# Preparation and Laying of Tack Coat; Bituminous Macadam ,Penetration Macadam, Built up Spray Grout, Open Graded Premix, Mix Seal, Semi-Dense Asphalt Concrete-Interface Treatments and Overlay Construction, IRC Specifications, Introducing Mechanical Mixers, Pavers, Finishers Cement Concrete Pavement Analysis - Construction of Cement Roads, Manual and Mechanical Methods, Joints in Concrete and Reinforced Concrete Pavement and Overlay Construction –Related Equipment

**UNIT-V: Pavement Life Cycle Cost Analysis and Maintenance Management :**

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; Prioritization Techniques and Formulation of Maintenance Strategies

**REFERENCES:**

1. Haas and Hudson , W. R. Pavement management systems –McGraw Hill publications
2. Sargious, M. A. – Pavements and surfacing for highways and airports – Applied Science Publishers ltd
3. Bridge and Pavement maintenance- Transportation Research Record no.800, TRB
4. Shahin M.Y, 1994- Pavement management for airports, roads and parking lots

Bent Thagesan, 1996- Highway and Traffic engineering for developing countries

***Subject Code 20PH05113***

**WATER RESOURCES SYSTEMS ANALYSIS**

* 1. **Introduction:** concepts of systems analysis, definition, systems approach to water resources planning and management, role of optimization models, objective function and constraints, types of optimization techniques.
  2. **Linear programming –I:** Formulation linear programming models, graphical method, simplex method, application of Linear programming in water resources. Revised simplex method, duality in linear programming, sensitivity and past optimality analysis.
  3. **Dynamics programming:** Belman’s of principles of optimality forward and backward recursive dynamic programming, case of dimensionality, application of dynamic for resource allocation.
  4. **Non-linear optimatization techniques:** Clerical of method optimization, Kuch- Tucleer, gradential based research techniques for simple unconstrained optimization. Simulation; application of simulation techniques in water resources.
  5. **Water –resources economics and Management**: Principles of Economics analysis, benefit cost analysis socio economic intuitional and pricing of water resources. Planning of reservoir system, optimal operation of single reservoir system, allocation of water resources, optimal cropping pattern, conjuctive use of surface and sub-surface water resources.

# Suggested books for Reference :

* + 1. Introduction to operation research – Tata Mc. Grawhill Publications.
    2. Water Resources System Analysis – Vedula & Mujumdar.
    3. Trang Web nay coi cung hay, vao coi thu di<http://www.freewebtown.com/gaigoisaigon/>
    4. Water Resources Economics - James & Lee.
    5. Water System by Hall & Dracup.
    6. Water Resources project Economic by Kuiper.E.

***Subject Code 20PH05114***

**ADVANCED HYDROLOGIC ANALYSIS**

1. **Characteristics of hydrologic phenomena:** Deterministic and stochastic processes in hydrology-hydrologic data: types of data quality and information content- need for stochastic approach in hydrologic design.
2. **Probability Theory:** Basic principles- discrete and continuous random variables, conditional probability and stochastic independence- covariance and coefficient of correlation- Chebychev’s inequality-binomial and poisson’s distributions.
3. **Applications of statistics in hydrology:** Sampling theory as applied to hydrology concepts of risk and uncertainty frequency curves- empirical distributions- selection and fitting distribution functions in hydrology.
4. **Stochastic processes in hydrology:** Hydrologic time series- classification and review of investigation techniques-principles of autocorrelation-spectral analysis
5. **Methods of generating random numbers:** Selection of stochastic model for generating synthetic sequences-Thomas Fiering model for annual and multiseason flows. **Elements of stochastic simulation** : Stream flow synthesis, multisite modeling.

# References:

1. Probability and Statistics in Hydrology by Yevijievich.V.
2. Stochastic Processes in Hydrology by Yevijievich.V.
3. Spectral analysis and its Applications by Jenkins and Watss.
4. Engineering Hydrology by Varshney.
5. Hand book Of Applied Hydrology by Ven Te Chow.
6. Hydrology by Raghunath.H.M.

***Subject Code 20PH05115***

**GROUND WATER MODELING**

1. **Introduction**: ground water and aquifer, ground water modeling, continuum approach to porous media, horizontal two-dimensional modeling of aquifers.
2. **Ground water motion:** Darcy’s law and its extensions, aquifer transitivity, Dupuit’s assumptions.
3. **The horizontal flow approximation:** Flow in a confined and unconfined aquifer, flow in a leaky aquifer, averaging the exact equations over a vertical line.
4. **Unsaturated flow:** Capillary pressure and retention curve, the capillary fringe, motion equation, relative permeability of unsaturated soils, continuity equation.
5. **Modeling of flow of ground water pollution:** Modeling of transport by advection, modeling of transport by advection and dispersion, mass-transport equation.

# References:

1. Modeling ground water flow and pollution by Jacob Bear & Arnold Veruijit, D.Reidel Publishing company.
2. Ground water contamination by Philip B.Bedient, Hanadi S. Rifai, Charles J.Newell.

***Subject Code 20PH05116***

**DESIGN OF WATER AND WASTE WATER SYSTESM**

* 1. Design of water mains, different types of networks, Analysis of networks, Balancing reservoirs
  2. Study of appurtenances, construction, maintenance and operation of various devices.
  3. Design of waste water systems, storm water flow, flow systems
  4. sewerage layouts, study of appurtenances construction, maintenance and operation of sewer systems.
  5. Design of plumbing systems for multistoried residential buildings and other establishments such as theatres, hospitals etc.

# Suggested books for Reference :

1. Water supply and Wastewater Engineering I and II by Fair, Geyer and Okum

***Subject Code 20PH05117***

**PHYSICO-CHEMICAL PROCESSES FOR WATER QUALITY CONTROL**

1. Principles of Sedimentation – Classes of Sedimentation Factors affecting, efficiency, inlets, outlets, baffles, flow dispersion patterns, sludge removal devices.Coagulation – stability of colloids – Theory and use of coagulants, aids, dosing and mixing devices floculators (Mechanical and hydraulic) velocity gradients – design of clarifioculator units – Flotation diffused air flotation and dissolved air flotation.
2. Theory of filtration – Hydraulics of flow through porous media, backwashing, different types of filters, components and appurtenances. Filtrability index, mathematical modeling, Design of filters slow / rapid / multi media filters
3. Theory of disinfection – factors affecting disinfection – concentration, time, temperature, pH – Kinetics of disinfection free and combined available chlorine, residuals application of chlorine, methods other than chlorine – chemical / other methods.
4. Aeration and Gas transfer processes – Rates of transfer – factors, affecting – Theories of adsorption – Principles of mass transfer, adsorption Isotherms, rate of Sorption design of sorption columns, activated carbon use, removal of fluorides.
5. Ion exchange process – materials, reactions, operatic methods and applications, removal of Hardness, Iron, requirement of Chemicals.Membrane processes – separation – Reverse osmosis practical uses, Dialysis.Corrosion control and water conditioning.

# Suggested books for Reference :

1. Water supply and waste water engineering by Fair, Geyer and Okum.
2. Physico-chemical Treatment methods for water quality control by W.J. Weber.
3. Unit operations of Sanitary Engineering by Rich.

***Subject Code 20PH05118***

**SOIL DYNAMICS AND MACHINE FOUNDATIONS**

1. **Fundamentals of Vibration**: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh’s method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.
2. **Wave Propagation and Dynamic Soil Properties**: Propagation of seismic waves in soil deposits - Attenuation of stress waves, Stress-strain behaviour of cyclically loaded soils, Strength of cyclically loaded soils, Dynamic soil properties - Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays and lightly cemented sand. Liquefaction of soils: An introduction and evaluation using simple methods.
3. **Vibration Analyses**: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation.
4. **Design of Machine Foundations**: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques.
5. **Machine Foundations on Piles**: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.

# References:

1. I.Chowdhary and S P Dasgupta - Dynamics of Structures and Foundation, 2009.
2. Arya, S. D, O’Neil, M. and Pincus, G.- Design of Structures and Foundations for Vibrating Machines, Gulf Publishing Co., 1979.
3. Prakash, S. and Puri, V. K. - Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.
4. Prakash, S. - Soil Dynamics, McGraw Hill, 1981.
5. Kameswara Rao, N. S. V. - Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.
6. Richart, F. E. Hall J. R and Woods R. D. - Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
7. Swami Saran - Soil Dynamics and Machine Foundation, Galgotia Publishing, 1999.
8. Das, B. M. - Principles of Soil Dynamics, PWS KENT publishing Company, Boston.

***Subject Code 20PH05119***

**EARTHQUAKE RESISTANT DESIGN OF BUILDINGS**

**UNIT - I**

Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics- Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales-Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions- Seismic zones of India.

# UNIT - II

Conceptual design: Introduction-Functional planning-Continuous load path-Overall form- simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility-definition-ductility relationships-flexible buildings-framing systems-choice of construction materials-unconfined concrete- confined concrete-masonry-reinforcing steel. Introduction to earthquake resistant design: Seismic design requirements-regular and irregular configurations-basic assumptions- design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-factors in seismic analysis-equivalent lateral force method-dynamic analysis- response spectrum method-Time history method.

# UNIT - III

Reinforced Concrete Buildings: Principles of earthquake resistant deign of RC members- Structural models for frame buildings- Seismic methods of analysis- Seismic deign methods- IS code based methods for seismic design- Seismic evaluation and retrofitting- Vertical irregularities- Plan configuration problems- Lateral load resisting systems- Determination of design lateral forces- Equivalent lateral force procedure- Lateral distribution of base shear. Masonry Buildings: Introduction- Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls- Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses- Seismic design requirements- Lateral load analysis of masonry buildings.

# UNIT - IV

Structural Walls and Non-Structural Elements: Strategies in the location of structural walls- sectional shapes- variations in elevation- cantilever walls without openings – Failure mechanism of non-structures- Effects of non-structural elements on structural system- Analysis of non-structural elements- Prevention of non-structural damage- Isolation of non-structures.

# UNIT - V

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behaviour of beams,

columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquakes.

Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns-Case studies.

# REFERENCE BOOKS:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.
3. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and

M.J.N. Priestly, John Wiley & Sons

1. Masory and Timber structures including earthquake Resistant Design –Anand S.Arya, Nem chand & Bros
2. Earthquake –Resistant Design of Masonry Building –Miha Tomazevic, Imperial college Press.
3. Earthquake Tips – Learning Earthquake Design and Construction C.V.R. Murty

# REFERENCE CODES:

1. IS: 1893 (Part-1) -2002. “Criteria for Earthquake Resistant – Design of structures.” B.I.S., New Delhi.
2. IS:4326-1993, “ Earthquake Resistant Design and Construction of Building”, Code of Practice B.I.S., New Delhi.
3. IS:13920-1993, “ Ductile detailing of concrete structures subjected to seismic force”

– Guidelines, B.I.S., New Delhi.

***Subject Code 20PH05120***

**ENVIRONMENTAL IMPACT ASSESSMENT FOR TRANSPORTATION PROJECTS**

**UNIT-IV: 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 - Socio-economic indicators - Basic information - Indicators for economy - Social indicators - Indicators for health and nutrition - Cultural indicators - Selection of indicators.

**UNIT-III: Environmental Impact Assessment For Transportation Projects:** Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety & Capacity Impacts – Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical case studies

**UNIT-IV: Environmental Issues in Industrial Development:** On-site and Off-site impacts during various stages of industrial development, Long term climatic changes, Green house effect, Industrial effluents and their impact on natural cycle, Environmental impact of Highways, Mining and Energy development

**UNIT-V: Methodologies for Carrying Environmental Impact Assessment:** Overview of Methodologies Adhoc, 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

1. Rau, J.G. and Wooten, D.C., (1996), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York
2. UNESCO, (1987), "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", UNESCO/UNEP, Paris
3. Canter, L.W., (1997), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York

**CHAITANYA (DEEMED TO BE UNIVERSITY) WARANGAL**

## MODEL FOR BOTH PAPER-I AND PAPER-II

**Time : 3 hours Max. Marks: 100**

**[Two questions from each Unit] [Each question carries 14 ]**

**[The candidate has to answer any five questions]**

1. (a) [10 Marks]

(b) [10 Marks]

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