JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR

Course Structure and Syllabi for Pre Ph.D
CIVIL ENGINEERING (2009-10)

PART – I

Choose any **one** subject of the following

S.NO	PAPER	PAPER CODE
1	Concrete Technology	09PH01101
2	Urban Drainage and Waste Water Treatment	09PH01102
3	Water Resources Systems Planning and Management	09PH01103
4	Ground Improvement Techniques	09PH01104
5	Highway Infrastructure Design	09PH01105

PART-II

Choose any **one** subject of the following

S.NO	PAPER	PAPER CODE
1.	Advanced Foundation Engineering	09PH01201
2.	Traffic Engineering	09PH01202
3.	Advanced Structural Design	09PH01203
4.	Artificial Neural Networks and Fuzzy Logic	09PH01204
5.	Engineering Hydrology	09PH01205
6.	Geo-Environmental Engineering	09PH01206
7.	Ground Water Management & Modelling	09PH01207
8.	Sustainable Construction Materials & Techniques	09PH01208
9.	Rehabilitation and Retrofitting of Structures	09PH01209
10.	Finite Element Methods	09PH01210
11.	Fracture Mechanics	09PH01211
12.	Structural Dynamics	09PH01212
13.	Expansive Soils	09PH01213
14.	Environmental Systems Engineering	09PH01214
15.	Pavement Analysis and Design	09PH01215

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Pre-Ph.D CIVIL ENGINEERING

(09PH01101) CONCRETE TECHNOLOGY

Unit-I

Cements and Admixtures: Portland cement – Chemical composition - Hydration, setting and fineness of cement – structures of hydrated cement – mechanical strength of cement gel– water held in hydrate cement paste – Heat of hydration of cement – Influence of compound composition on properties of cement – tests on physical properties of cement – I.S. specifications – Different types of cements – Chemical Admixtures.

UNIT – II

Aggregates: Classification of aggregate – particle shape and texture – Bond, strength and other mechanical properties of aggregate specific gravity, Bulk density, porosity, absorption and moisture in aggregate – soundness of aggregate – Alkali – aggregate reaction I Thermal properties – sieve analysis – Fineness modulus – grading curves – grading requirements – practical grading – Road note No. grading of fine and coarse aggregates gap graded aggregate – maximum aggregate size.

UNIT – III

Fresh concrete: Workability – factors affecting workability – measurement of workability by different tests – Effect of time and temperature on workability – segregation and bleeding – mixing and vibration of concrete – quality of mixing water.

UNIT – IV

Hardened Concrete: Water/cement ratio-Abram's law – Gel space ratio – effective water in mix – Nature of strength of concrete – strength in tension and compression- Griffith's hypothesis – factors affecting strength – autogenous healing –Relation between compression and tensile strength – curing and maturity of concrete Influence of temperature on strength – Steam curing – testing of Hardened concrete – compression tests – tension tests – factors affecting strength – flexure tests – splitting tests – Non destructive testing methods.

UNIT – V

Elasticity, Shrinkage and Creep: Modulus of elasticity – dynamic modulus of elasticity – Poisson's ratio – Early volume changes – swelling – Drying shrinkage - Mechanism of shrinkage – factors affecting shrinkage – Differential shrinkage – moisture movement carbonation shrinkage-creep of concrete – factors influencing creep – relation between creep and time – Nature of creep – Effect of creep.

UNIT – VI

Mix Design: Proportioning of concrete mixes by various methods – fineness modulus, trial and error, mix density, Road Note. No. 4, ACI and ISI code methods – factors in the choice of mix proportions – Durability of concrete – quality control of concrete – Statistical methods – High strength concrete mix design

UNIT –VI I

Components of modern concrete and constituent materials-1: Light weight concretes – light weight aggregate, light weight aggregate concrete- Mix design – Cellular concrete No-fines concrete – High density concrete – Fiber reinforced concrete – Different types of fibers - = factories affecting properties of FRC – Applications polymer concrete – types of polymer concrete properties of polymer concrete applications.

UNIT – VIII

Components of modern concrete and constituent materials-2: Mineral admixtures in concrete – fly ash-silica fume- Highly reactive Metakaolin (HRM) – Rice husk ash – ready mix concrete – Ferro cement – High Performance Concrete – Self compacting concrete

References:

1. "**Micro structure, Properties and Materials**" P. Kumar Mehta, Panlo, J.N. Monterio – CONCRETE Tata McGraw Hill

2 "**Concrete Technology**" A.R. Santha Kumar Oxford University Press, New Delhi

3.. "**Properties of Concrete**" Neville, A.M Pearson Education Asis, 2000

4."**Concrete Technology- Theory and Practice**" M.S. Shetty – S. Chand & Co. Ltd., NewDelhi

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Pre-Ph.D CIVIL ENGINEERING

(09PH01102) URBAN DRAINAGE AND WASTE WATER TREATMENT

UNIT – I

Urban Hydrological Cycle, Effects of Urbanization on Catchments Hydrology, Need for Urban Drainage System, Planning Objectives, Interaction of Urban and Surrounding Areas.

UNIT – II

Approaches to Urban Drainage, Urban Wastes and Urban Runoff Options for Waste Disposal, Separate and Combined System's, Open Channels and Closed Conduits, Wastewater and Storm water Reuse, Data Requirements, Master Drainage Plans.

UNIT –III

Elements of Drainage System, Conveyance Elements, Appurtenances, Overflow Structures, Runoff Control, Pumping Stations, Design Parameters, Design Period, Catchments, Physical Parameters, Process Parameters, Rainfall, water Quality Parameters, Instrumentation for Data Collection. Hydraulic Design of Conveyance Elements, Sizing of Sewers and Drainage Channels, Design of Appurtenances, Layout of Road Drainage, Layout of Pumping Stations.

UNIT – IV

Operation and Maintenance of Urban Drainage Systems, Interaction of Urban Drainage and Solid Waste Management, Cleansing of Sewers and Drains, Repairs and Maintenance, Planning.

UNIT – V

Wastewater Treatment Technologies: Primary and Secondary Treatment, Sedimentation, sedimentation with Coagulation, Filtration, Activated Sludge Process, trickling Filters, Sludge Treatment.

UNIT – VI

Tertiary Treatment Systems: Nitrogen removal, Phosphorous removal, biological phosphorus removal, advanced biological systems, chemical oxidation.

UNIT – VII

Low-cost Treatment Methodologies - Aerobic ponds, facultative ponds, aerated ponds, anaerobic ponds.

UNIT – VIII

Wetlands : Introduction, definition, classification, delineation, Identification methods, Importance of wetlands, Human impacts, wetland protection, mitigation, Management, Designed ecosystem, water recycling, soil filters, Constructed wetlands

References:

1. **Industrial Wastewater Treatment**, M.N. Rao, A.K. Dutta Oxford and IBH Publishing House, 1987.
2. **Waste Water Treatment and Disposal** by Metcalf Eddy & Co., Mc. Graw Hill Co., 1993
3. **Water and wastewater Treatment** by Hammer and Hammer: Prentice-Hall 1998
4. **"Urban Hydrology ",**Hall, M.J. (1984), Elsevier Applied Science Publishers.
5. **"Manual on Drainage in Urban Areas",** Geiger, W.F., Marsalek, J. Zudima and Rawls, G. J. (1987 2 Volumes, UNESCO, Paris.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01103) WATER RESOURCES SYSTEMS PLANNING AND MANAGEMENT

UNIT – I

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

UNIT – II

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

UNIT – III

Methods of Systems Analysis: Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models, Classical Optimization Techniques, Non-Linear Programming, Gradient Techniques, Genetic Algorithm, Stochastic Programming, Simulation, Search Techniques, Multi Objective Optimization.

UNIT – IV

Water Quantity Management: Surface Water Storage Requirements, Storage Capacity and Yield, Reservoir Design, Water Allocations for Water Supply, Irrigation.

UNIT –V

Hydropower and Flood Control, Reservoir Operations, Planning of an Irrigation System, Irrigation Scheduling, Groundwater Management, Conjunctive Use of Surface and Subsurface Water Resources, Design of Water Conveyance and Distribution Systems.

UNIT –V I

Water Quality Management: Water Quality Objectives and Standards, Water Quality control Models, Flow Augmentation, Wastewater Transport Systems, River Water Quality Models and Lake Quality Models.

UNIT – VII

Environmental Impact Assessment – Preparation of EIA and EIS, Impact Assessment Methodologies, Impact mitigation, EMP.

UNIT –VIII

Legal Aspects of Water & Environment Systems: Principles of Law Applied to Water Rights and Water Allocation, Water Laws, Environmental Protection Law, Environmental Constraints on Water Resources Development.

References

1. **"Water Resources Systems Planning and Analysis",** Loucks, D.P., Stedinger, J.R. and Haith, D.A.(1982)Prentice Hall Inc. N York
2. **"Water Resources Systems Planning and Manag;ement",** Chaturvedi, M.C. (1987), Tata McGraw Hill Pub. Co., N Delhi
3. **"Water Resources Systems",** Hall. W.A. and Dracup, J.A. (1975),Tata Mc Graw Hill Pub. N Delhi
4. **"Economics of Water Resources Planning",** James, L.D. and Lee (1975) , M c Graw Hill Inc. N. York
5. Biswas, A.K. (1976) "Systems Approach to Water Mana;gement", Mc Graw Hill Inc. N York
6. **"Applied Water Resources System Planning",** Major, D.C. and Lenton, R.L., (1979), Prentice-Hall Inc., N. Jersey
7. **"Operations Research "**,Taha H A (1996), Prentice Hall of India, N Delhi.
8. EIA, Canter, McGraw Hill Publication

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01104) GROUND IMPROVEMENT TECHNIQUES

UNIT – I

Introduction to Ground Modification: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility, Emerging Trends in ground improvement.

UNIT –II

Mechanical Modification: Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro-floatation, Blasting, Dynamic consolidation, pre-compression and compaction piles, Field compaction control.

UNIT –III

Hydraulic Modification: Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains.

UNIT – IV

Physical and Chemical Modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen, Grouting: categories of grouting, Art of grouting, Gout materials, Grouting techniques and control.

UNIT –V

Reinforced Earth Technology: Concept of soil reinforcement, Reinforcing materials, Backfill criteria, Art of reinforced earth technology, Design and construction of reinforced earth structures.

UNIT –V I

Soil Confinement Systems: Concept of confinement, Gabbion walls, CRB walls, Sand bags, Evergreen systems and fabric formwork.

UNIT –VII

Miscellaneous Techniques: Design, Construction and applications of stone columns lime columns and cofferdams

UNIT –VIII

Types of Geo-textiles and their applications in various constructions.

References:

1. **Engineering, principles of ground modification** – Manfred R.Hansmann Mc Graw-Hill pub. Co., New York.
2. **Construction and Geotechnical methods in Foundation Engineering** – Robert M.Koerner McGraw-Hill Pub. Co., New York.
3. **Foundation Engineering Hand book** – Winterkorn and Fang Van Nostrand Reinhold Co., New York.
4. **Aris C.Stamatopoulos & Panaghiotis C.Kotzios – Soil Improvement by Preloading** – John Wiley & Sons Inc. Canada.
5. **Ground Improvement Techniques** – P. Purushothama Raj Laxmi Publications (P) Limited.

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Pre-Ph.D CIVIL ENGINEERING

(09PH01105) HIGHWAY INFRASTRUCTURE DESIGN

UNIT – I

GEOMETRIC DESIGN OF HIGHWAYS: Functional Classification of Highway System; Design Controls – Topography, Driver characteristics, Vehicle Characteristics, Traffic, Capacity and Level of Service, Design Speed. Objectives of Geometric Design

UNIT – II

HIGHWAY CROSS SECTION ELEMENTS: Carriageway, Shoulders, Formation, Right of way; Kerbs, foot paths, Medians- design specifications; Pavement Surface characteristics – Skid Resistance, factors affecting Skid resistance, Measurement of Skid Resistance; Road Roughness, measurement of Road roughness; Camber, Objectives of Camber, design standards.

UNIT – III

HORIZONTAL ALIGNMENT: Objectives of horizontal curves; Super elevation – Need for Super elevation; Method of computing super elevation; Minimum Radius of Curve; Methods of attainment of super elevation; Extra widening on Curves; Transition Curves – Objectives and Design.

UNIT – IV

VERTICAL ALIGNMENT: Gradients – Types of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves and Design criteria for Vertical Curves; Combination of Vertical and Horizontal Curves – Grade Compensation;

UNIT – V

SIGHT DISTANCES: Sight Distances – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance; Importance of Sight Distances for Horizontal and Vertical Curves.

UNIT – VI

INTERSECTION DESIGN: Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelisation, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards**.**

UNIT – VII

SIGNS AND ROAD MARKINGS: Types of Road Signs; Guidelines for the provision of Road Signs; Cautionary Signs, Regulatory Signs, Information Signs – Design standards; Road markings – Objectives of Road Markings; Types of Road Markings ; Role of Road markings in Road Safety and Traffic Regulation; Specification for Road Markings. Highway Appurtenances – Delineators, Traffic Impact Attenuators, Safety Barriers.

UNIT – VIII

MISCELLANEOUS ELEMENTS: Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays – Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design.

References:

1. **Principles and Practice of Highway Engineering**, L.R.Kadiyali and N.B.Lal, Khanna Publications
2. **Traffic Engineering and Transportation Planning**, L.R.Kaadiyali, Khanna Publications
3. **Highway Engineering**, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
4. **IRC Codes for Signs**, Markings and Mixed Traffic Control in Urban Areas.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01201) ADVANCED FOUNDATION ENGINEERING

UNIT – I

SHALLOW FOUNDATIONS-I: General requirements of foundations. types of shallow foundations and the factors governing the selection of a type of shallow foundation. Bearing capacity of shallow foundations by Terzaghi's theory and Meyerhof's theory (derivation of expressions and solution to problems based on these theories). Local shear and general shear failure and their identification

UNIT –II

SHALLOW FOUNDATIONS-II: Bearing capacity of isolated footing subjected to eccentric and inclined loads. Bearing capacity of isolated footing resting on stratified soils- Button's theory and Siva Reddy analysis. Analysis and structural design of R.C.C isolated, combined and strap footings.

UNIT –III

DEEPFOUNDATIONS-I: Pile foundations-types of pile foundations. estimation of bearing capacity of pile foundation by dynamic and static formulae. Bearing capacity and settlement analysis of pile groups. Negative skin Friction, Pile load tests.

UNIT – IV

DEEP FOUNDATIONS-II: Well foundations-Elements of well foundation. forces acting on a well foundation. Depth and bearing capacity of well foundation. Design of individual components of well foundation (only forces acting and principles of design). Problems associated with well sinking.

UNIT – V

SHEET PILE WALLS-1: Cantilever sheet piles and anchored bulkheads, Earth Pressure diagram, Determination of depth of embedment in sands and clays

UNIT – VI

SHEET PILE WALLS-2: Timbering of trenches-Earth Pressure diagrams-forces in struts.

UNIT – VII

FOUNDATIONS IN PROBLEMATIC SOILS-1: Foundations in black cotton soils-basic foundation problems associated with black cotton soils. Lime column techniques-principles and execution.

UNIT –VIII

8. **FOUNDATIONS IN PROBLEMATIC SOILS-2:** Under reamed piles - principle of functioning of under reamed pile-Analysis and structural design of under reamed piles. Use of Cohesive Non -Swelling (CNS) layer below shallow foundations.

References:

1. **Analysis and Design of Foundations and Retaining Structures**-Shamsher Prakash,Gopal Ranjan and Swami Saran.
2. **Analysis and Design of Foundations**-E.W.Bowles
3. **Foundation Design and Construction**-Tomlinson
4. **Foundation Design**-Tang.
5. **Geotechnical Engg**-Venkatramaiah

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Pre-Ph.D CIVIL ENGINEERING

(09PH01202) TRAFFIC ENGINEERING AND TRANSPORTATION PLANNING

UNIT – I

TRAFFIC STUDIES: Basic Traffic Parameters – Speed, Volume and Density – Definitions and their interrelationship – Traffic Volume Studies: Types, Methods and Analysis of Traffic Volume Data; Speed and Delay Studies: Types of Speeds, Speed Study Methods, Data Collection, analysis and Presentation; Use of Statistical Methods in Traffic Volume and Speed Data Analysis.

UNIT – II

HIGHWAY CAPACITY: Highway Capacity and Level of Service; Factors affecting Highway Capacity and Level of Service; Concept of PCU Factors; Capacity of Rural Highways and Basic freeways ; Capacity of Urban Roads; Capacity of Intersections and Factors influencing; Capacity of Rotary Intersections.

UNIT – III

TRANSPORTATION PLANNING PROCESS: Definition of Study Area; Zoning Principles; Types of Surveys: Home Interview Studies, Commercial Vehicle Surveys, Road Side Interview Methods,Public Transport Studies, Land Use Inventory; O-D Matrix and Desire Line Diagram.

UNIT – IV

TRIP GENERATION: Four Stage UTP Process; Travel Demand Models; Sequential Models and Direct Demand Models; Factors affecting Travel Demand; Trip Generation; Multiple Regression Analysis; Category Analysis; Aggregate and Disaggregate Models.

UNIT- V

TRIP DISTRIBUTION: Trip Distribution Models- Growth Factor Models: Uniform Growth Factor, Average Growth Factor, Fratar Method and Furness Method; Limitations of Growth factor Models; Gravity Model – Calibration of Gravity Model.; Opportunity Models.

UNIT –V I

TRAFFIC ASSIGNMENT: Purpose of Traffic Assignment; Assignment Techniques-All-or-Nothing Assignment,Multiple Route Assignment, Capacity restraint assignment; Use of Diversion Curves in Assignment.

UNIT –VII

MODE SPLIT: Factors affecting Mode Split; Pre–distribution Mode Split; Post-Distribution Mode Split; Advantages and Disadvantages; Probit, Logit and Discriminant Analysis in Mode Split.

UNIT –VIII

ECONOMIC EVALUATION OF TRANSPORT PLANS: Need for Economic Evaluation; Principles of Economic Evaluation; Costs and Benefits of Transportation Projects; Methods of Economic Analysis- Benefit Cost Ratio Method; Net Present Value Method; Internal Rate of Return Method; Comparison of various methods and their suitability.

References:

1.**Traffic Engineering and Transport Planning**, L.R.Kadiyali, Khanna Publishers,New Delhi.
2.**Fundamentals of Transportation Engineering**, C.S.Papacostas, Prentice Hall India Ltd
3.**Transportation Engineering**-An Introduction, C.J.Khisty and B.Kent Lall, Prentice Hall India Ltd

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01203) ADVANCED STRUCTURAL DESIGN

UNIT – I

Deflection of Reinforced concrete beams and Slabs: Introduction- Short-term Deflection of beams and Slabs- Deflection due to Imposed loads- Short- term deflection of beams due to applied loads- Calculation of deflection by IS 456- Calculation of deflection by BS 8110- Deflection calculation by Euro code- ACI Simplified Method- Deflection of continues beams by IS 456- Deflection of Cantilevers- Deflection of Slabs

UNIT – II

Estimation of Crack width in Reinforced Concrete Members: Introduction- Factors affecting Crack width in beams- Mechanism of Flexural cracking- Calculation of crack widths- Simple Empirical method- Estimation of Crack width in beams by IS 456 of BS 8110- Shrinkage and Thermal Cracking

UNIT –III

Design of Reinforced Concrete Deep Beams: Introduction- Minimum Thickness- Steps of Designing deep beams- Design by IS 456- Design according to British Practice- ACI Procedure for design of deep beams- Checking for local failures- Detailing of deep beams

UNIT – IV

Shear in Flat Slabs and Flat Plates: Introduction- Checking for One-way (wide beam) shear- Two-way (Punching) shear- Permissible punching shear- Shear due to Unbalanced Moment (Torsion moments)- Calculation of j values- Strengthening of column areas for moment transfer by torsion which produces shear- Shear Reinforcement Design- Effect of openings in Flat slabs- Recent Revisions in ACI 318- Shear in Two – way Slabs with beams.

UNIT – V

Design of Reinforced Concrete Members for Fire Resistance: Introduction- ISO 834 standard heating conditions- Grading or classifications- Effect of High temperature on steel and concrete- Effect of high temperatures on different types of structural members- Fire resistance by structural detailing from Tabulated data- Analytical determination of the ultimate bending moment capacity of reinforced concrete beams under fire- Other considerations

UNIT – VI

Design of plain concrete walls: Introduction- Braced and Un-braced walls- Slenderness of walls- Eccentricities of vertical loads at Right angles to wall- Empirical design method for plane concrete walls carrying axial load- Design of walls for In-plane Horizontal forces- Rules for detailing of steel in concrete walls

UNIT –VII

Shear walls-1: Introduction- Classification of shear walls- Classification according to behavior- Loads in shear walls-

UNIT – VIII

Shear walls-2: Design of Rectangular and flanged shear walls- Derivation of formula for moment of Resistance of Rectangular shear walls

References:

1. **Reinforced concrete Structural Elements**: P.Purushothaman Behavior- analysis and Design- TATA Mc Graw Hilll.
2. **Reinforced Concrete Designers Hand book**- C.E. Reynolods and J.C. Steedman A view point publication.
3. **Limit State Design of Reinforced Concrete Structures** by P.Dayaratnam- oxford & IBH Publishers- 2004 edition.
4. **Advanced RCC** by N.Krishna Raju - CBS Publishers & Distributors.
5. **Reinforced cement concrete structures** – Devadas Menon
6. **Advanced** R.C.C. Design – P.C. Vargheese

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01204) ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC

UNIT – I

Introduction: A New Breed of Processor: The Brain; The Engineering of the Brain; A world of Fuzzy Thinking; Crisp versus Fuzzy Logics; Fuzzy and Neural Networks; Where Are Fuzzy Neural Networks Headings; Objectives;

UNIT – II

Biological Neural Networks: The Axon: A Transmission Line; The Synapse; The Synapse; A Bio-computer Types of Synapses; The Developing Neuron: Forming Networks; Neuronal Specialization; The Cell's Biological Memory; Weighting Factor; Factors Affecting Potassium-ion Flow; Firing, in a Nutshell; Neuronal; Diversity; Specifications of the Brain; The Eye's Neural Network; Retina Structure; Rods and Cones; From photons to Electrons; A Photochemical Chain Reaction Organization and Communication of the Retina Neural Network; Image Processing in the Retina; Visual Pathways;

UNIT –III

Artificial Neural Networks: Concepts: Neural Attributes; Artificial Neural Networks; Same Mathematics Again; Modeling; Basic Model of a Neuron; Learning in Artificial Neural Networks; Supervised Learning; Unsupervised Learning; Reinforced Learning; Competitive Learning; The Delta Rule; Gradient Descend Rule; Hebbian Learning Characteristics of ANNs; Important ANN Parameters; Artificial Neural Network Topologies; Modeling ANNs; ANN Learning and Program; Learning Algorithms; Discrimination Ability; Linearly Separable ANNs; Multilinear ANNs; Nonlinear Separable ANNs; ANN Adaptability; The Stability-Plasticity Dilemma;

UNIT – IV

Neural Network Paradigms - 1: Mc Culloch- Perception; The Perception; ADALINE and MADALINE Models; Winner- Takes- All Learning Algorithm; Back – Propagation Learning Algorithm; Learning with the Back- Propagation Algorithm; Mathematical Analysis; Application; Criticism ; Cerebellum Model Articulation Controller (CMAC); Adaptive Resonance theory (ART) Paradigm; The ART Algorithm; Hopfield Model; Mathematical Analysis; The Hopfield Learning Algorithm Discrete-Time Hopfield Net; Competitive Learning Model ; .

UNIT – V

Neural Network Paradigms - 2: Memory Type Paradigms; Random Access Memory (RAM); Content Addressable Memory (CAM); Bidirectional Associative Memory (BAM); Content Addressable Memory (TAM); Linear Associative Memory (LAM); Real –Time Models; Linear Vector Quantization (LVQ); self- Organizing Map (SOM); Probabilistic Neural Network (PNN); Radial Basis Function (RBF); Time-Deal Neural Net (TDNN); Cognitron and Neocognitron Models; Simulated Annealing; Boltzmann Machine; Other Paradigms; Restricted Coulomb energy (RCE); Culbertson's Model; Encephalon Project; Cellular Neural Networks; Logicon Projection Networks (LPN); Probabilistic RAM (Pram-256); Neural Acceleration Chip (NAC);

UNIT – VI

Fuzzy Logic - 1: Propositional Logic; The Membership Function; Fuzzy Logic; Fuzzy Rule Generation; De-fuzzification of Fuzzy Logic; Time – Dependent Fuzzy Logic; Crisp Logics; Fuzzy Logics; Temporial Fuzzy Logic (TFL); Time – Invariant Membership Function; Time – Variant Membership Function;

UNIT –VII

Fuzzy Logic - 2: Intervals; Semi large Intervals; Interval Operators; Temporial Fuzzy Logic Syntax; Applying Temporial Fuzzy; Operators; Deffuzzification of temporal Fuzzy Logic Example; Applicability of TFL IN Communications Systems; Temporal Fuzzification; Rules and Temporal Defuzzification.

UNIT – VIII

Fuzzy Neural Networks: Fuzzy Artificial Neural Network (FANN); Neural – fuzzy Control; Traditional Control; Neural Control; Fuzzy control; Fuzzy- Neural;

References:

1. **Neural Networks** by Haykins, Mc Graw Hill publishers
2. **Neural Networks and Fuzzy systems** by Bart Kosko
3. **Neural Network Design** by Martin Hagan, Howard B Demuth and Mark Beale

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Pre-Ph.D CIVIL ENGINEERING

(09PH01205) ENGINEERING HYDROLOGY

UNIT – I

World's Water Resources: Hydrology and its Scope, hydrologic cycle Precipitation Rainguage net work. Checks of rainfall data. Double mass curve, Depth intensity duration relationships.

UNIT – II

Infiltration: Factors affecting, Measurement of infiltration, Infiltration curve and infiltration indices.

UNIT – III

Runoff: The steam flow hydrograph, Hydrograph separation, Unit hydrograph and Synthetic unit hydrographs, S-Curve hydrograph, IUH models-Nash Computation of reservoir capacity:

UNIT – IV

Hydrology of Droughts: Definition: types of droughts, Effects of drought, Combating drought, reducing runoff losses, reducing evaporation and deep percolation. Efficient use of stored soil water.

UNIT – V

Hydrology of floods: Causes of floods, flood discharge formulae and envelope curves, Flood frequency analysis.

UNIT – VI

Probability distributions as applied to Hydrology: Discrete and Continuous Probability Distribution Functions - Binomial, Poisson, Normal, Lognormal, Exponential, gamma Distributions, Extreme Value Distributions, Gumbel and Log – person Type III distribution.

UNIT –VII

Flood control: Flood control dams, detention basins, levels, diversion channels, flood channel improvement and schemes.

UNIT – VIII

Flood routing: routing through a reservoir by I.S.D, method, channel routing by Muskingun's method.

References

1. **A Text Book of Hydrology** by P.Jayarami Reddy.
2. **Hydrology** Wiley Eastern Ltd., H.M. Raghumath 1986.
3. **Engineering Hydrology** by Subrahmanyam
4. **Stochastic Hydrology** by P.Jayarami Reddy.

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Pre-Ph.D CIVIL ENGINEERING

(09PH01206) GEO-ENVIRONMENTAL ENGINEERING

UNIT I

Introduction to Ground water contamination, pollutant transport and ground water remediation. Sources and Types of ground water contamination – introduction – under ground storage tanks, Land fills, surface impoundment's, waste disposal injection wells, Septic system, Agricultural wastes, and application, radioactive contamination, other sources of contamination.

UNIT II

Data Collection methods: Introduction, Geological data acquisition – Drilling methods – Solid flight auger drilling – Hollow stem auger drilling – Wet rotating drilling – Hand auger soil boring –

UNIT III

Sample collection – Soil core logging – Cone penetration testing – Geophysical methods; Hydrologic data acquisition – monitoring well construction – well material – Screen interval selection – Installation procedure – Survey specification – Protective casing requirements – Well development procedures; Acquisition loft soil and Ground water quality data.

UNIT IV

Contaminant Transport Mechanisms: Introduction – Advection process – Diffusion – Dispersion process – Diffusion – Mass transport Equations : Derivation of advection dispersion equation for solute transport; One Dimensional Models – Continuous source in one dimension – Instantaneous source in one dimension – Adsorption effects – Transport in one dimensional with first order decay

UNIT V

Sorption: The concept of sorption, Factors influencing sorption – Contaminant characteristics, Soil characteristics, Fluid media characteristics. Sorption Isotherms: Linear sorption Isotherm – Freundlich Sorption isotherm – Langmuir Sorption Isotherm Sorption effects on fate and transport of pollutants.

UNIT VI

Flow and Transport of Pollutants in Unsaturated zone: Capillarity, soil-water characteristic curves, Unsaturated Hydraulic conductivity, Governing equation for unsaturated flow, measurement of soil properties.

UNIT VII

Non – Aqueous Phase Liquids (NAPLs): Introduction – Comparison of fate of dissolved mass versus NAPL mass- Types of NAPLs – LNAPL – DNAPL;

UNIT VIII

NAPL Transport – general process – NAPL transport at the pore level p- Downward Migration of DNAPLs – in saturated zone – NAPL movement through Vadose zone – LNAPL behavior at the water table – NAPL Transport at the site level – LNAPL conceptual models – DNAPL conceptual models. NAPL transport

References:

1. **Ground water Contamination (Transport and Remediation)** By Philip. B.Bedient, Hanadi, S. Rifai & Charles. J.Newell, Prentice Hall Publishers.
2. **Geoenvironmental Engineering** by Sharma & Krishna Reddy, John Wiley & Sons
3. **Introduction to Environmental geotechnology** by Hsai-Yang Fang, CRC Press

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01207) GROUND WATER MANAGEMENT & MODELLING

UNIT – I

Fundamental concepts-1: Types of aquifers, Vertical distribution of soil water below the ground, Porosity specific yield, hydraulic conductivity and storage coefficient, their practical significance

UNIT – II

Fundamental concepts-2: Darcy's law and its validity. Derivation of basic differential equation and its solutions, Ground Water flow contour and their applications. Tracer techniques in ground water flow studies.

UNIT – III

Ground Water resources evaluation-1: Steady and unsteady radial flow of ground water towards a well in confined and unconfined aquifers, Analysis of pumping test data – Theis type curve method, Jacob's method for Time and Distance draw down tests, Theis recovery method

UNIT – IV

Ground Water resources evaluation-2: Estimation of well losses, Yield of open wells – methods of evaluation. Image wells. Geo-hydrologic boundaries

UNIT – V

Ground water Management-1: Water Balance Studies, Perennial Yield, Necessity of artificial recharge techniques. Conjunctive use of surface and ground water. Management of coastal aquifers – Ghyben Herzberg relation ,upcoming of Saline Water- Methods of control of salt water intrusion.

UNIT – VI

Ground water Management-2: Ground water Quality, Ground Water pollution, elements and source of pollution their effects and remedial measures.

UNIT – VII

Aquifer Modeling-1 – Electrical analog models – RC Network techniques. Principles of digital Modeling of aquifers, Numerical Modeling – Flow Modeling Using Finite Difference Methods

UNIT – VIII

Aquifer Modeling-2: Flow Modeling Using Finite Element Methods- Advection Process – Diffusion and Dispersion Process – Solute Transport Modeling.

References:

1. **Ground Water Hydrology** by D.K. Todd.
2. **Ground Water Hydrology** by Raghunath.
3. **Geohydrology** by Davis and Dewiest
4. **Geohydrology** by K. R. Karanth
5. **Development Evaluation and Monitoring of Ground Water** by K.R.Karanth.
6. **Domenice(1972) "Concepts and Models in Groundwater Hydrology"** McGraw Hill Inc. N.York

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01208) SUSTAINABLE CONSTRUCTION MATERIALS AND TECHNOLOGY

UNIT – I

. a) **Housing Scenario** Introducing- Status of urban housing- Status of Rural Housing-
b) **Housing Finance:** Introducing- Existing finance system in India- Government role as facilitator- Status at Rural Housing Finance- Impedimental in housing finance and related issues

UNIT – II

Land use and physical planning for housing: Introduction- Planning of urban land- Urban land ceiling and regulation act- Efficiency of building bye laws- Residential Densities

UNIT – III

Housing the urban poor: Introduction- Living conditions in slums- Approaches and strategies for housing urban poor

UNIT – IV

Development and adopting sustainable construction technology: Introduction- Adoption of innovative cost effective construction techniques- Adoption of pre-cast elements in partial prefabrication- Adopting of total prefabrication of mass housing in India- General remarks on pre cast rooting/flooring systems- Economical wall system- Single Brick thick loading bearing wall- 19cm thick load bearing masonry walls- Half brick thick load bearing wall- Fly ash-gypsum brick for masonry- Stone Block masonry- Adoption of pre-cast R.C. plank and join system for roof/floor in the building

UNIT – V

Alternative building materials for sustainable construction: Introduction- Substitute for scarce materials- Ferro-cement- Gypsum boards- Timber substitutions- Industrial wastes- Agricultural wastes – cement-soil blocks for masonry – stabilized mud construction

UNIT –V I

Low cost Infrastructure services: Introducing- Present status- Technological options- Low cost sanitation's- Domestic wall- Water supply- energy

UNIT – VII

Rural Housing: Introduction- traditional practice of rural housing continuous- Mud Housing technology- Mud roofs- Characteristics of mud- Fire resistant treatment for thatched roof- Soil stabilization- Rural Housing programs

UNIT – VIII

Construction in Disaster Prone areas: Introduction- Earthquake- Damages to houses- Traditional Housing in disaster prone areas- Type of Damages of non-engineered buildings- Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions- Requirement's of structural safety of thin pre-cast roofing units against - Earthquake forces- Status of R& D in earthquake strengthening measures- Floods-cyclone- future safety

References:

1. **Building materials for low** –income houses – International council for building research studies and documentation's.
2. **Hand book of low cost housing** by A.K.Lal – Newage international publishers.
3. **Properties of Concrete** – Neville A.M. Pitman publishing Limited- London.
4. **Light weight concrete**- Academic kiado- Rudhai .G – Publishing home of Hungarian Academy of Sciences 1963.
5. **Low cost Housing** – G.C. Mathur
6. **Modern trends in housing in developing countries** – A.G. Madhava Rao- D.S. Ramachandra Murthy & G.Annamalai

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Pre-Ph.D CIVIL ENGINEERING

(09PH01209) REHABILITATION AND RETRO FITTING OF STRUCTURES

UNIT – I

General : Quality assurance for concrete construction, As built concrete properties, strength, permeability, volume changes, thermal properties, cracking.

UNIT – II

Influence on serviceability and Durability:- Effects due to climate, temperature, chemicals, wear and erosion, design and construction errors, corrosion mechanism, Effects of cover thickness and cracking methods of corrosion protection, inhibitors, resistant steels, coatings cathode protection.

UNIT – III

Maintenance and Repair Strategies:- Inspection, Structural Appraisal, Economic appraisal, components of quality assurance, conceptual bases for quality assurance schemes.

UNIT – IV

Materials for Repair-1: - Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement

UNIT – V

Materials for Repair-2: - Polymer concrete, sulphur infiltrated concrete, ferro-cement, Fibre reinforced concrete, Slurry Infiltrated Fibrous Concrete

UNIT – VI

Techniques for Repair-1;- Rust eliminators and polymers coating for re-bars during repair, foamed concrete, mortar and dry pack, vacuum concrete

UNIT –VII

Techniques for Repair-2;- Gunite and shotcrete - Epoxy injection, Mortar repair for cracks, shoring and underpinning.

UNIT –VIII

Examples of repairs to structures:- Repairs to overcome low member strength, Deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure.

References:

1. **Dension Campbell, Allen and Harold Roper, Concrete Structures, Materials**, Maintenance and Repair, Longman Scientific and Technical, U.K, 1991.
2 **Repair of concrete Structures,** . RT. Allen and S.C. Edwards, Blakie and sons, UK, 1987.
3. **Concrete Technology – Theory and practice**, MS. Shetty S.Chand and company, New Delhi, 1992.
4. **Training course notes on damage assessment and Repair in low cost housing** Santhakumar, S.R. RHDC-NBO Anna University, Madras, July, 1992.
5. Raikar, R.N. learning from failures – deficiencies in Design, construction and service– R & D centre (SDCPL), Raikar Bhavan, Bombay, 1987.
6. **Estate Management**, N. Palaniappan, Anna Institute of Management, Madras Sep. 1992.
7. **Structural Assessment**, F.K. Garas, J.L. Clarke, GST Armer Butterworths, UK April 1987.
8. **Concrete chemicals – Theory and applications**, A.R. Santhakumar, Indian society for construction Engineering and Technology, Madras. 1993 (In press)

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Pre-Ph.D CIVIL ENGINEERING

(09PH01210) FINITE ELEMENT METHODS

UNIT – I

Introduction-Concepts of FEM –steps involved –merits &demerits –energy principles – Discretization –Rayleigh –Ritz method of functional approximation.

UNIT – II

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 – III

One Dimensional FEM-Stiffness Matrix for Beam and Bar elements shape functions for ID elements –static condensation of global stiffness matrix-solution –Initial strain and temperature effects.

UNIT – IV

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 –static condensation.

UNIT – V

Iso-parametric formulation-Concept, Different iso-parametric elements for 2d analysis-Formulation of 4-noded and 8-noded iso-parametric quadrilateral elements –Lagrangian elements-serendipity elements.

UNIT – VI

Axi-symmetric analysis –bodies of revolution- axi-symmetric modeling –strain displacement relationship-formulation of axi-symmetric elements.

UNIT – VII

Three Dimensional FEM-Different 3-D elements, 3D strain –displacement relationship-formulation of hexahedral and iso-parametric solid element.

UNIT – VIII

Non-liner FE analysis – Introduction- Non-linearity – Material Non-linearity – Geometric Non- linearity – various methods of modeling

References:

- **Finite element method** by O.C.Zienkiewicz
- **Finite element analysis _Theory & programming** by C.S.Krishna murthy
- **Introduction to finite element method** –J.N.Reddy
- **Finite element Procedures** – K.J. Bathe
- **Introduction to finite element methods** – John F Abel and Chandrakant Desai

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D CIVIL ENGINEERING

(09PH01211) FRACTURE MECHANICS

UNIT – I

Summary of basic problems and concepts:

Introduction-A crack in a structure-The stress at a crack tip-The Griffith criterion- The crack opening displacement criterion-Crack Propagation- Closure

UNIT – II

The elastic crack – tip stress field

The Airy stress function-Complex stress functions -Solution to crack problems- The effect of finite size- Special cases- Elliptical cracks- Some useful expressions

UNIT – III

The crack tip plastic zone:

The Irwin plastic zone correction- The Dugdale approach- The shape of the plastic zone- Plane stress versus plane strain- Plastic constraint factor- The thickness effect

UNIT – IV

The energy principle:

The energy release rate- The criterion for crack growth- The crack resistance (R curve)- Compliance & The J integral - Definition only

UNIT – V

Plane strain fracture toughness:

The standard test- Size requirements- Non-Linearity- Applicability-

UNIT – VI

Plane stress and transitional behavior:

Introduction- An engineering concept of plane stress- The R curve concept

UNIT –VII

The crack opening displacement criterion:

Fracture beyond general yield- The crack tip opening displacement- The possible use of the CTOD criterion

UNIT – VIII

Determination of stress intensity factors:

Introduction- Analytical and numerical methods- Finite element methods An ariel view only- Experimental methods

References:

1. **Elementary engineering fracture mechanics** -David Broek- Battelle- laboratories- columbus- Ohieo- USA

2. **Fracture and Fatigue Control in Structures** - John M.Barsom- Senior consultant United states Steel corporation & Stanley T.Rolfe- Ross H.Forney Professor of Engineering University of Kansas. & Stanley T.Rolfe- Ross H.forney Professor of Engineering- University of Kansas

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Pre-Ph.D CIVIL ENGINEERING

(09PH01212) STRUCTURAL DYNAMICS

UNIT – I

Theory of Vibrations: Introduction –Elements of a vibratory system – degrees of freedom-continuous systems –lumped mass idealization –Oscillatory motion –Simple harmonic motion –pictorial representation of S.H.M - free vibrations of single degree of Freedom (SDOF) systems –un-damped and Damped –Critical damping –Logarithmic decrement –Forced vibrations of SDOF systems-Harmonic excitation –Dynamic magnification factor- Bandwidth.

UNIT –II

Introduction to structural Dynamics: Fundamental objective of dynamic analysis-types of prescribed loading- Methods of discretization- Formulation of the equations of motion.

UNIT – III

Single degree of Freedom System: Formulation and solutions of the equation of motion - free Vibration response –response to harmonic, periodic, Impulsive and general Dynamic loading – Duhamel integral

UNIT – IV

Multi Degree of Freedom System-1: selections of the degree of freedom –Evaluation of structural property matrices-Formulation of the MDOF equations of motion –Un-damped free vibrations-Solution of Eigen value problem for natural frequencies and mode shapes

UNIT – V

Multi Degree of Freedom System-2: Analysis of dynamic response –Normal coordinates – Uncoupled equations of motion –Orthogonal properties of normal modes-mode superposition procedure

UNIT –VI

Practical vibration analysis: Stodola method- Fundamental mode analysis –analysis of second and higher modes –Halzer method –basic procedure –transfer matrix procedure

UNIT – VII

Introduction to Earthquake analysis: Introduction –Excitation by rigid base translation – Lumped mass approach -SDOF and MDOF system- I.S code methods of analysis.

UNIT – VIII

Continuous system: Introduction –Flexural vibrations of beams- Elementary case-Equation of motion –Analysis of un-damped free shapes of simple beams with different end conditions-principles of application to continuous beams.

References:

- **Dynamics of structures** by Clough & Penziem
- **Structural dynamics** by Mario Paz
- **" code of practice for earthquakes resistant design of structures"** I.S:1893(latest)

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Pre-Ph.D CIVIL ENGINEERING

(09PH01213) EXPANSIVE SOILS

Unit-I:

Origin and occurrence of expansive soils-problems associated with expansive clays-identification and classification based on mineralogical composition

Unit-II

X-Ray diffraction, differential thermal analysis and electron microscopy-identification by index properties

Unit-III

Clay-water system – Ion distribution in clay –water systems-diffuse double layer-Gouy Chapman theory-cation exchange

Unit-IV

Mechanisms of swelling-osmotic pressure concept-Importance of mineralogical details in swelling-soil suction-measurement in laboratory and field

Unit-V

Swell potential-swelling pressure-factors affecting-direct measurement from laboratory testing-stresses in an in-situ soil mass-factors affecting heave-methods of heave prediction

Unit-VI:

Shear strength of expansive clays-Katti's concept of bilinear stress- state variables-Fredlund's three dimensional approach to shear strength and swelling behaviour of expansive clays

Unit-VII

Foundation practices in expansive clays-sand cushion-belled piers-under reamed piles-CNS layer technique

Unit-VIII

Expansive soil stabilization with lime-lime soil columns and lime slurry pressure injection-stabilization with admixtures

References:

1. **Foundations on expansive soils** – F.H. Chen, Elsevier Publishing Co.
2. **Search for solutions to problems in black cotton soils** – R.K. Katti, Indian Goe.Tech.Journal, Volume 1, 1971
3. **Fundamentals of soil behaviour** – J.K. Mitchell, John Wiley&Sons

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Pre-Ph.D CIVIL ENGINEERING

(09PH01214) ENVIRONMENTAL SYSTEMS ENGINEERING

UNIT – I

Water and wastewater Treatment Processes: Introduction – characteristics of water and wastewater - Treatment of Water and wastewater for different requirements – Water and wastewater Treatment Processes - Layout of Treatment Plant.

UNIT – II

Plain Sedimentation: Principles of Sedimentation – Settling velocities – Design consideration - Types of Sedimentation Tanks – problems.

UNIT – III

Coagulation And Flocculation: Chemical Coagulation – Alum, Iron Salts and other coagulants for use as Coagulants Coagulant aids – secondary sedimentation tanks – design.

UNIT – IV

Filtration: Gravity Sand Filters - types of sand filters – slow sand filter – construction and theory of operation of Slow Sand Filters – maintenance – efficiency - Rapid Sand Filter – construction and operation of filter – back wash - The Under Drainage System – efficiency of Rapid Gravity Sand Filters - Comparison between Slow and Rapid Gravity Filters – Pressure Filter - Designs of Filters, Examples.

UNIT – V

Sanitation: Definition of environmental sanitation by W H O Communicable disease, epidemic-endemic-pandemic - sporadic diseases. Methods of infection transmission - Diseases of intestinal origin, vector-borne/arthropod-borne diseases. Domestic waste disposal - without water carriage and with water carriage systems. General liquid waste treatment system- household and community waste disposals. Insect vectors - flies and mosquitoes - life histories - Diseases transmitted by vectors - Eradication methods - biological control versus chemical control - rural and urban remedial measures - rats and rodent control - fumigation - disinfection - Insecticides - use and abuse.

UNIT –VI

Solid Waste Management – Sources, Systems of collection-transportation - methods of solid waste disposal – Reuse, recycle, energy recovery, Hazardous waste management.

UNIT –VII

Air Pollution - Sources, effects, control of Air Pollution, Plume dispersion, plume rise, Pollutant dispersion models, Automobile Pollution and Control.

UNIT – VIII

Environmental Law: Environmental protection and laws-Environmental (Protection) Act, 1986 - The Water (Prevention and Control) Act, 1974, The Air (Prevention and Control) Act, 1981, Laws relating to Hazardous Substances and Factories Act, 1948 - Hazardous Waste (Management and Handling) Rules 1989, EIA.

References:

1. **Environmental Engineering Design** – Sincero and Sincero, Mc Graw Hill Publication.
2. **Water Supply and Sanitary Engineering**, Peavy and Rowe, Mc Graw Hill Publications
3. **Air Pollution Control** – Martin Crawford, Mc Graw Hill Publication
4. **Municipal and Rural Sanitation** - Ehlers, V.M. and Steel, E.W.Mc.GRAW-HILL Book Company, Inc. V. edition. 1987.
5. **Environmental Sanitation**, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
6. **Environmental Protection and Laws**, Jadhav and Bhosale, V.M.Himalaya publishing House.

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Pre-Ph.D CIVIL ENGINEERING

(09PH01215) PAVEMENT ANALYSIS AND DESIGN

UNIT – I

FACTORS AFFECTING PAVEMENT DESIGN: Variable Considered in Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Axle Types of Rigid Chassis and Articulated Commercial Vehicles, Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure, Contact Pressure, EAL and ESWL Concepts, Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane, Directional Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads.

UNIT – II

STRESSES IN PAVEMENTS: Vehicle-Pavement Interaction: Transient, Random & Damping Vibrations, Steady State of Vibration, Experiments on Vibration, Stress Inducing Factors in Flexible and Rigid pavements.

UNIT –III

STRESS IN FLEXIBLE PAVEMENTS: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two and Three Layered Systems, Fundamental Design Concepts.

UNIT – IV

STRESSES IN RIGID PAVEMENTS: Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses, Stresses in Dowel Bars & Tie Bars.

UNIT – V

MATERIAL CHARACTERISTICS: CBR and Modulus of Subgrade Reaction of Soil, Mineral aggregates – Blending of aggregates, binders, polymer and rubber modified bitumen, Resilient, Diametral Resilient and Complex (Dynamic) Modulie of Bituminous Mixes, Permanent Deformation Parameters and other Properties, Effects and Methods of Stabilization and Use of Geo Synthetics.

UNIT –VI

DESIGN OF FLEXIBLE PAVEMENTS: Flexible Pavement Design Concepts, Asphalt Institute's Methods with HMA and other Base Combinations, AASHTO, IRC Methods,

UNIT –VII

DESIGN OF RIGID PAVEMENTS: Calibrated Mechanistic Design Process, PCA, AASHTO & IRC Specifications, Introduction to Prestressed and continuously Reinforced Cement Concrete Pavement Design, Rigid Pavement Design for Low Volume Rural Roads.

UNIT – VIII

DESIGN OF OVERLAYS: Types & Design of Overlays: AI's Principal Component Analysis & IRC Methods of Overlay Design, Importance of Profile Correction Course.

References:

1. **Design of Functional Pavements**, Nai C. Yang, McGraw Hill Publications
2. **Concrete Pavements**, AF Stock, Elsevier, Applied Science Publishers
3. **Principles of Pavement Design**, Yoder.J.&Witczat Mathew, W. John Wiley & Sons Inc
4. **Pavement Analysis & Design**, Yang H. Huang, Prentice Hall Inc.
5. **Pavement and Surfacings for Highway & Airports**, Micheal Sargious, Applied Science Publishers Limited.
6. **IRC Codes for Flexible and Rigid Pavements design**
7. **Dynamics of Pavement Structures**, G. Martineek, Chapmen & Hall Inc.

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