

# **Solapur University, Solapur**



**Ph.D. Course Work**

**Civil Engineering**

**(Faculty of Engineering & Technology)**

Solapur University, Solapur  
Civil Engineering  
(Faculty of Engineering & Technology)  
Syllabus for Ph.D. Course Work



<i>Sr. No</i>	<i>Subject</i>	<i>Examination Scheme Theory paper</i>
1	Research Methodology and Information Communication Technology (Common to all Branches of Engineering & Technology)	100 Marks
2	Advances in Civil Engineering	100 Marks
3	Elective – Advanced Developments in Civil Engineering	100 Marks

Elective –

- (1) Structural Engineering and Concrete Technology
- (2) Geotechnical Engineering and Construction Management
- (3) Environmental Engineering and Water Resources Engineering

*Note – Candidate shall select an elective in consultation with research guide.*

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## **Paper-II: Advances in Civil Engineering**

**Maximum Marks: 100**

**Paper Duration: 3 Hours**

### **Unit 1:**

#### **Numerical methods for Engineering Computations**

Fundamentals of numerical methods, Error analysis, Differentiation, integration, interpolation and extrapolation, Solution of non-linear algebraic and transcendental equation.

Solution of systems of linear and non-linear algebraic equations, Eigen value problems. Solution of partial differential equation, initial and boundary value problems. Computer oriented algorithms, Numerical solution of problems related to shallow and deep foundation, Flow through porous media, Settlement computations under different loading conditions and consolidation.

### **Unit 2:**

#### **Statistics and Probability**

Various distribution binomial, normal, log-normal, Poisson, Beta B, gamma distribution, Pearson type I,II & II distribution test of significance, Chi square test, correlation, simple and multiple regression, Markov Chain, Markov process.

Correlation and Regression and Multivariate Analysis: Bivariate Frequency Distribution Scatter Diagram, Correlation Analysis, Multiple Regression Analysis-Non linear Regression. Use of regression analysis in resources management.

#### **Reference Books:**

1. Montgomery, Douglas C. (2007), 5/e, Design and Analysis of Experiments, (Wiley India)
2. Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley India)

3. Numerical methods for Scientific and Engineering Computation by M.K. Jain, S.R.K Iyengar & R.K. Jain and published by Wiley Eastern Ltd.
4. Numerical methods for Engineering Computation by D.V. Griffiths and I. M. Smith, Published by Blackwell Scientific Publication.
5. Numerical methods in FORTRAN by John M. Mc & M. G. Salvadori, Published by Prentice Hall of India
6. Numerical analysis in Geotechnical Engg. By C. S. Desai

### **Unit 3:**

#### **Remote Sensing and GIS in Planning and Disaster management**

Aerial photography, Application of aerial photography in town planning studies, Satellite remote sensing. Application of remote sensing in regional studies, G.I.S applications in planning and its role in remote sensing, Disaster, Prevention, Preparedness (Warning), Relief.

#### **Environmental Management and Impact Assessment**

Environmental management, problems and strategies; Future strategies; Multidisciplinary Environmental strategies, Environmental Impact Assessment (EIA), Sustainable Development (SD), Initial Environmental Examination (IEE), Environmental Impact Statement (EIS), environmental appraisal, Environmental Audit (EA); Environmental impact factors and areas of consideration, measurement of environmental impact.

#### **Reference Books:**

1. Michael Hord, R. Remote sensing methods and application, John Wiley and Sons, New York, 1986.
2. Harvey M. Rubenstein , A Guide to site and Environmental planning, New York

### **Unit 4:**

#### **Optimization Techniques**

Optimization techniques, various models, objectives functions and constraints, convex and concave functions, regions and sets. Linear programming, two phase method, method of Big M, dual. Sensitivity analysis. Allocation problems, Transportation problem, Assignment problem.

#### **Reference Books:**

1. Jorge Nocedal and Stephen Wright; Numerical Optimization, Springer, 2<sup>nd</sup> edition, (2006)
2. S. S. Rao; Engineering Optimization: Theory and Practice, Wiley, 4th edition, (2009)

## OR (*for unit 4 only*)

### **Unit 4:**

#### **Infrastructure Development**

Role of infrastructure development in employment generation and improvement of the National economy. Various agencies associated with infrastructure development in India as regards various sectors. Indian government policy, Roads and buildings, communication, water supply, irrigation, power energy sectors, ports and aviation, health and educational services, rural development. Pre-requisites necessary to ensure success for switching over from public sector management to private sector management, issues in developing, funding and managing infrastructure projects, role, responsibility of project management consultants.

#### **Reference Books:**

1. India Infrastructure Report – Rakesh Mohan
2. Infrastructure Today - Magazine
3. Document of five year plans, published by Govt. of India.

### **Unit 5:**

#### **Deep Foundations**

Axial capacity of groups of piles, Settlement of single piles and groups. Uplift capacity (including under-reamed piles). Negative skin friction. Pile load tests. Pile integrity tests. Codal provisions. Caissons-types, construction techniques, difficulties in construction. Design of well foundation. Foundations in difficult soils: expansive soils, chemically aggressive environment, soft soils, fill, regions of subsidence.

#### **Reference Books:**

1. Engineering with Geosynthetics: ed. G. Venkatappa Rao, GVS Suryanarayana Raju, Tata McGraw Hill Publishing Co. Ltd.
2. ASTM and Indian Standards on Geotextiles.
3. Koerner, R. M.: Designing with Geosynthetics, Prentice Hall, NJ.
4. Jones, C.J.E.P. Reinforcement and soil structures, Butter worth Publications.

## **Unit 6:**

### **Advanced Concrete Technology:**

Light weight concrete, ultra light weight concrete, vacuum concrete, mass concrete, waste material based concrete, shotcreting, guniting, sulphur concrete and sulphur infiltrated concrete, jet cement concrete (ultra rapid hardening), gap graded concrete, no fines concrete, high strength concrete, high performance concrete and under water concreting.

### **Reference Books:**

1. Concrete technology by Santhakumar- Oxford University Press.
2. Concrete technology-A. M. Neville and Brooks
3. Properties of Concrete- Murdock.
4. Properties of Concrete-P. K. Mehta.
5. Concrete Technology- M. S. Shetty.
6. Fiber Reinforced Cement Composite- P. N. Balguru & P. N. Shah.



# Solapur University Solapur

Ph. D. Course work

Civil Engineering

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Paper-III: Elective: Structural Engineering & Concrete Technology

Maximum Marks: 100

Paper Duration: 3 Hours

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## STRUCTURAL ENGINEERING

### Unit 1:

#### Stiffness Method

Concept of stiffness. Linearly elastic structures. Derivation of stiffness equation, stiffness coefficients. Development of stiffness matrix. Analysis of beam, portals, trusses ( $DKI \leq 3$ ). Sinking of support.

### Unit 2:

#### Member Oriented Stiffness Method

Stiffness matrices of beam, truss, plane frame. Transformation of matrices on structure axis. Overall joint stiffness matrix and nodal load vector, assembly rules. Calculation of member end forces.

### Unit 3:

#### Finite Element Method

Fundamentals of finite element. Stress strain relations, strain displacement relations, plane stress and plane strain problems. Compatibility conditions. 1 D element- 2 noded, 3 noded etc. Application of FEM for the analysis of plane truss, continuous beam and simple plane frame problems

### Unit 4:

#### Finite Element Method 2D Elements:

Use of displacement functions. Pascal's triangle. Types of 2 D elements- triangular, rectangular, quadrilateral. Formulation of element stiffness matrix

## Reference Books:

1. **W. Weaver , J.M. Gere** - “*Matrix Analysis of framed structures*”- CBS publishers and Disributers,1986
2. **H. C. Martin** –“ *Introduction to Matrix Methods of Structural analysis*” - International text book Company, 1996
3. **G.S. Pandit & S. P. Gupta** – “*Structural Analysis, A Matrix Approach*”- Tata Mc Graw-Hill, 1981
4. **C.S. Reddy** – “ *Basic structural Analysis*”- Tata Mc Graw-Hill, 1996
5. **L. S. Negi and R. S. Jangid**- “*Structural Analysis*”- Tata Mc Graw-Hill, 1997
6. **S. Rajasekaran**- “*Computational Structural Mechanics*”, PHI, New Dehi 2001.
7. **Cook R. D., Malkan D. S. & Plesta M.** - “*Concepts and Application of Finite Element Analysis*” - 3<sup>rd</sup> Edition, John Wiley and Sons Inc., 1989
8. **Zienkeiwicz. O.C**- “*The Finite Element Method*” - Tata McGraw Hill Co. Ltd., New Delhi.
9. **Krishnamoorthy C S** -, “*Finite Element Analysis*”- Tata McGraw Hill
10. **Chadrupatla, Tirupathi R.**- “*Finite Element Analysis for Engineering and Technology*”- University Press, India
11. **J.F. Abel and Desai. C.S.** – “*Introduction to the Finite Element Method*” - Affiliated East West Press Pvt. Ltd., New Delhi.
12. **S.S. Bhavikatti** -“*Finite Element Analysis*” - New Age International Publishers, New Delhi.

## ADVANCED CONCRETE TECHNOLOGY

### Unit 5:

Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly ash cement concrete mixes, design of high density concrete mixes Advanced non-destructive testing methods: ground penetration radar, probe penetration, pull out test, break off maturity method, stress wave propagation method, electrical/ magnetic methods, nuclear methods and infrared thermography, core test.



**Unit 6:**

Historical development of fibre reinforced concrete, properties of metallic fiber, polymeric fibres, carbon fibres, glass fibres and naturally occurring fibers. Interaction between fibres and matrix (uncracked and cracked matrix), basic concepts and mechanical properties: tension and bending.

**Reference Books:**

1. Concrete technology by Santhakumar- Oxford University Press.
2. Concrete technology-A.M.Neville and Brooks
3. Properties of Concrete- Murdock.
4. Properties of Concrete-P.K.Mehta.
5. Concrete Technology- M.S.Shetty.
6. Fiber Reinforced Cement Composite- P.N.Balguru & P.N.Shah.



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**Paper-III: Elective: Geotechnical Engineering and Construction Management**

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## **GEOTECHNICAL ENGINEERING**

### **Unit 1:**

#### **Advanced Geotechnical Engineering**

Stress distribution under earth embankments and evaluation of settlement profile. Field problems to monitor movement of slopes, foundations, etc.

#### **Advanced Foundation Engineering**

Foundations in difficult soils: expansive soils, chemically aggressive environment, soft soils, fill, regions of subsidence.

#### **Geotextiles**

Definitions, functions, properties, and application of Geotextiles, design of Geotextile applications, definitions, functions, properties and applications of geomembranes, design of geomembranes applications, Geotextiles associated with geomembranes, testing on geotextiles, environmental efforts, ageing and weathering.

### **Unit 2:**

#### **Rock mechanics and Tunneling**

Deformation characteristics of rocks and its measurement. Instrumentation, Underground excavation and subsidence. Bearing capacity of homogeneous as well as discontinuous rocks. Soil Dynamics and Geotechnical Earthquake Engineering. Soil behaviour under dynamic loads. Seismic response, strong ground motion, its parameters and their estimation, seismic hazard analysis, local site effects and design ground motion, seismic slope stability.

### **Unit 3:**

#### **Geo-environmental Engineering**

Landfills, in ash ponds and tailing ponds, and in rocks. Detection, control and remediation of subsurface contamination; Engineering properties and geotechnical reuse of waste.

#### **Soil Structure Interaction**

Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits. Interaction analysis of piles and pile groups. Elastic continuum and elastoplastic analysis of piles, Non-linear load-deflection response.

#### **Reference Books:**

1. Bowles J E (1996), Foundation Analysis and Design, McGraw Hill.
2. Das B M (1997), Advanced Soil Mechanics, Taylor and Francis.
3. Das B M (1993), Principles of Soil Dynamics, Brooks/Cole
4. Coduto D P (2001), Foundation Design: Principles and Practices, Prentice -Hall
5. Kaniraj S R (1988), Design Aids in Soil Mechanics and Foundation Engineering, Tata McGraw Hill
6. Poulos H G and Davis E H (1980), Pile Foundation Analysis and Design, John Wiley and Sons
7. Karl Terzaghi (1954), Theoretical Soil Mechanics, Chapman and Hall
8. Rock Mechanics in Engineering Practice: Stag and Zienkiewez, John Willey & Sons
9. J.C. Jagger and N.G.W. Cook(1971), Fundamentals of Rock Mechanics, Methuen and Co., London.
10. Sarsby R (2000), Environmental Geotechnics, Thomas Telford
11. Hsai-Yang Fang, Introduction to Environmental Geotechnology, CRC Press.
12. Kramer S L (1996), Geotechnical Earthquake Engineering, Prentice Hall
13. Wolf J P (1985), Dynamic Soil-Structure Interaction, Prentice-Hall

14. G. Venkatappa Rao, GVS Suryanarayana Raju, Engineering with Geosynthetics: Tata McGraw Hill Publishing Co. Ltd.
15. ASTM and Indian Standards on Geotextiles.
16. Koerner, R. M.: Designing with Geosynthetics, Prentice Hall, NJ.
17. Jones, C.J.E.P. Reinforcement and soil structures, Butter worth Publications.

## **CONSTRUCTION MANAGEMENT**

### **Unit 4:**

#### **Project Management**

CPM, PERT networks, Cost/ Resource based networks, scheduling, monitoring and updating, resource planning and allocation, LOB, network crashing, time cost trade off. Computer Application in Construction Management- Software for network analysis, CPM, PERT, GERT, decision tree analysis.

#### **Financial Aspects of Construction Projects**

Means of Finance, Working Capital Requirements, Project Cash Flow Projections and Statements, Project Balance Sheet, Profit Loss Account Statements, Concept of Debt Equity Ratio, Tax – Need and types

### **Unit 5:**

#### **Risk Management**

Introduction, Principles, types, origin, risk control, Use of mathematical models: Sensitivity Analysis, Break Even Analysis, Simulation Analysis, Decision Tree Analysis, Risk identification, analysis and mitigation of project risks, Role of Insurance in Risk Management.

### **Unit 6:**

#### **Material Management:**

Material planning, accounting and material reconciliation. Systems of material classification. Deterministic and probabilistic models and applications, ABC analysis, replenishment and replacement policies, VED analysis, lead time demand, purchase planning, EOQ model. Wastage audit at site, Site waste material management plan. Computer applications based upon available software.

**Reference Books:**

1. Construction Engineering and Management by. S. Seetharaman, Umesh Publications, New Delhi
2. Total Project Management- the Indian Context by P. K. Joy Macmillan India Ltd. Financial Management by Prasanna Chandra, Tata Mc Graw Hill Publicaitons
3. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi
4. Materials Management – Gopalkrishnan and Sunderasan, Prentice Hall Publications
5. Construction Planning, Methods & Equipment: Puerifoy – Tata McGraw Hill
6. Operations Research- Hamdy A. Taha
7. Engineering Optimisation- S. S. Rao



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#### Paper-III: Elective: Environmental Engineering and Water Resources Engineering

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##### Unit 1:

##### Water Treatment

Water Quality: Requirement, Standards, Stream & Effluent standards. Water purification, physical, chemical and biological processes. Unit operations, unit processes. Aeration, Sedimentation, Coagulation & flocculation, Filtration: Adsorption, adsorption, Ion Exchange membrane Processes, RO, Ultrafiltration, Electrolysis and Disinfection.

Waste waters Sources and characteristics, BOD progression & its formulations, Fundamentals of Design of W/W treatment systems- Primary, secondary and tertiary; ASP, Nitrification-denitrification, Ponds and aerated Lagoons, Attached Growth Biological Treatment Systems: TF, RBC, Activated Bio-filters, USAB, Expanded granular bed reactors,. Sludge Digestion: anaerobic and aerobic, Waste water reclamation and reuse, Effluent disposal.

##### Unit 2:

##### Air Quality Monitoring and Control Techniques

Air pollutants: Sources, classification, Combustion Processes, pollutant emission, Effects on Health, vegetation, materials, atmosphere, Reactions of pollutants Scales of AP studies, effects as per scales, Air sampling, pollution measurement methods, Ambient air quality and emission standards, Air Act, legislation and regulations, Removal of gaseous pollutants. Particulate emission control; bioscrubers, biofilters, Indoor air quality Models for Water and Air Quality Introduction to Mathematical Models: Modelling approaches to water quality - classification and considerations in selecting models, DO model for streams, Streeter - Phelps model -oxygen 'sag' curve, Benthic oxygen demand Air quality models : Gaussian dispersion model, Regional air quality models.

### **Unit 3:**

#### **Environmental Management and Impact Assessment**

Environmental management, problems and strategies; Future strategies; multidisciplinary Environmental strategies, Environmental impact assessment (EIA), Sustainable development (SD), initial environmental examination (IEE), environmental impact statement (EIS), environmental appraisal, environmental audit (EA); Environmental impact factors and areas of consideration, measurement of environmental impact, SWM: Waste Management -Sources, Classifications, Characteristics, Generations, Onsite Handling and Storage, Collection, Transfer Recycling and Disposal Techniques of Municipal Solid Waste (MSW), Hospital Waste Management.

#### **Reference Books:**

1. Manual on water supply and Treatment ", CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.
2. Manual on Sewerage and Sewage Development ", CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1993.
3. B.A. Hauser, " Practical Hydraulics Hand Book ", Lewis Publishers, New York, 1991.
4. M.J. Hammer, " Water and Wastewater Technology ", Regents/Prentice Hall, New Jersey, 1991.
5. Wastewater Treatment and Reuse: Metcalf and Eddy.
6. Air Pollution: Stern
7. Wastewater Treatment for Pollution Control; Arceivala and DR. Asolekar
8. Industrial Wastewater Treatment: Nelson – Numero
9. Industrial Wastewater Treatment: Dr. A. D. Patwardhan
12. Zipparro, V.J., Davis' Handbook of Applied Hydraulics Fourth Edition. McGraw Hill, 1993. ISBN: 0070730024
- 15 Eckenfelder, W.W. (Jr.), Industrial Water Pollution Control, (2nd Ed). McGraw-Hill, 1989. ISBN: 007018903X.
- 19 American Water Works Association, Water Quality and Treatment: A Handbook of Community Water Supplies. McGraw Hill, 1998. ISBN: 0070015406

20 Kawamura, S., Integrated Design and Operation of Water Treatment Facilities.  
Wiley and Sons, 2000. ISBN: 0471350931

## **Unit 5:**

### **Water Resources Engineering**

Water resources systems analysis, design and management for water supply, irrigation, drainage, hydropower, flood control, droughts. Surface and ground water hydrology, stochastic hydrology, physical and numerical modeling, use of finite difference, finite element and boundary element methods.

#### **Reference Books:**

1. Principles of water resources planning and management – Goodman
2. Applied hydrology – Linsley Kolhar and Paulhas (McGraw Hill)

## **Unit 6:**

### **Introduction to Weather and Climate**

Atmosphere and its constituents, Synoptic observations- surface and upper air. Tropical meteorology: Easterly Waves, ET-ITCZ, Inversion. Monsoon - Onset, Activity, Withdrawal, Breaks, Depressions, Easterly Jet Stream. Post Monsoon - Cyclones in the Indian Seas, N. E. Monsoon.

Global Climatology - Global distribution of pressure and temperature at m.s.l. in winter and summer, distribution of annual rainfall and its variability, distribution of moisture and clouds. Vertical distribution of temperature. General circulation of atmosphere. Development of monsoons. Major categories of world climates.

Indian Climatology - Different seasons. Distribution of Means Sea level pressure/temperature in different seasons. Wind circulation and temperature distribution over India in lower, middle and upper troposphere in different seasons. Indian rainfall in different seasons. Indian summer monsoon, onset, withdrawal, rainfall distribution, inter annual variability of monsoon. Main synoptic pressure systems causing weather over India in different seasons.



**Reference Books:**

1. Atmosphere, Weather and Climate R.J. Barry and R.G. Chorley (Methuen Publication)
2. General Climatology” Critchfield
3. South West Monsoon” by Y.P. Rao (IMD Publication) .
4. An Introduction to Meteorology by S. Pettersen
5. Elements of meteorology by Miller, Thompson and Paterson
6. General Meteorology by H.R. Byer
7. Monsoon by P.K. Das
8. Tropical Meteorology by T.N. Krishnamurthy
9. Tropical Meteorology by Riel.
10. Tropical Meteorology Vol 1, 2, 3, by G.C. Asnani