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A Structural Instrumentation & Material Science
B Computational Techniques

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<td>STC106</td>
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### Semester - IV

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IE: Internal Evaluation  
MSE: Mid - Session Evaluation  
ESE: End Sem. Examination  
TW: Term Work  
P/OE: Performances/Oral Exam
STC 101  MATRIX ANALYSIS OF STRUCTURES

Teaching scheme: 03 L+01 T=04  Credit: 04
Evaluation scheme: 20 IE+10 MSE+70 ESE  Total marks: 100
Duration of ESE: 4 Hrs.

COURSE OBJECTIVES

After completion of syllabus students will able to,
1) Understand basic concepts of stiffness method of matrix analysis.
2) Analyse the structures using stiffness method.
3) Apply softwares of structural analysis based on this method.

UNIT - I
Introduction to stiffness and flexibility approach, Stiffness matrix for spring, Bar, torsion, Beam (including 3D), Frame and Grid elements, Displacement vectors, Local and Global co-ordinate system, Transformation matrices, Global stiffness matrix and load vectors, Assembly of structure stiffness matrix with structural load vector, application to spring and bar problems.

UNIT - II
Analysis of Plane Truss, Space Truss by Stiffness Method

UNIT - III
Analysis of Beam, Plane Frame, Space Frame by Stiffness Method.

UNIT - IV
Analysis of Plane Grid by Stiffness Method

UNIT - V
Analysis for member loading (self, Temperature & Imposed), Inclined supports, Lack of Fit, Initial joint displacements. Effect of shear deformation, internal member end releases.

UNIT - VI
Analysis of building systems for horizontal loads, Buildings with and without rigid diaphragm, various mathematical models and introduction to Solution techniques.

Text Books:-
Reference Books:-

STC 102 ADVANCED CONCRETE STRUCTURES

Teaching scheme: 03 L+01 T=04                    Credit: 04
Evaluation scheme: 20 IE+10 MSE+70 ESE      Total marks: 100
Duration of ESE: 4 Hrs.

COURSE OBJECTIVES

After completion of syllabus students will able to get the knowledge about the design of
1. Bridges.
2. Water tanks.

UNIT – I
Analysis and design of Multi storied buildings, calculation of loads, Approximate analysis, Preliminary sizing, IS:875, IS:1893 recommendations, Ductile detailing, Calculation of earthquake forces.

UNIT – II
Analysis and Design of Elevated service Reservoirs, IS Recommendations for wind & earthquake, Ductile detailing, Design of Concrete Chimney.

UNIT – III

UNIT – IV
Analysis and design of Silos and Bunkers. IS recommendations.

Text Books:
2. Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005
Reference Books:
OBJECTIVE:
□ To study and understand the properties of recent materials used in construction.

UNIT I
SPECIAL CONCRETES
Concretes, Behaviour of concretes - High Strength and High Performance Concrete
– Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete.

UNIT II
METALS
Steels - Types of structural steels, special steel, alloy steel, stainless steel, light gauge steel,
Corrosion of concrete in various environments. Corrosion of reinforcing steel. Electro-chemical
process, measures of protection. New Alloy Steels, Aluminum and its Products –Coatings to
reinforcement Applications.

UNIT III
COMPOSITES
Plastics –Reinforced Polymer, Ferro-cement, material and properties. Polymers in Civil
Engineering Polymers, fibres and composites, Fibre reinforced plastic in sandwich panels,
Brick Ferro-cement Composite.

UNIT IV
OTHER MATERIALS

UNIT V
SMART AND INTELLIGENT MATERIALS
Smart and Intelligent Materials for intelligent buildings - Special features. green building
materials, waste products, reuse and recycling.

UNIT VI
Ceramic Materials: Classification, Refractories, glass, glass wool, mechanical, thermal and
electrical properties, fire resistance materials, Uses and application.

TEXT BOOKS:

REFERENCES:
5. Aitkens , High Performance Concrete, McGraw Hill, 1999
8. ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.
STC104 BUILDING SERVICES

Teaching scheme: 03 L+01 T=04  Credit: 04
Evaluation scheme: 20 IE+10 MSE+70 ESE  Total marks: 100
Duration of ESE: 3 Hrs.

OBJECTIVE:
After studying this subject students will be able to understand the importance of various building services.

UNIT: I
Water Supply
Water quality, Purification and treatment- water supply systems-distribution systems in small towns -types of pipes used- laying jointing ,testing-testing for water tightness plumbing system for building-internal supply in buildings- municipal bye laws and regulations - Rain Water Harvesting.

UNIT: II
Sanitation
Sanitation in buildings-arrangement of sewerage systems in housing -pipe systems- storm water drainage from buildings -septic and sewage treatment plant - collection, conveyance and disposal of town refuse systems.

UNIT: III
Electrical Systems
Types of wires , wiring systems and their choice -planning electrical wiring for building - main and distribution boards -transformers and switch gears -modern theory of light and colour -synthesis of light -luminous flux -candela- lans of illumination-lighting design-design for modern lighting.

UNIT: IV
HVAC
Ventilation and its importance-natural and artificial systems-Window type and packaged airconditioners- chilled water plant -fan coil systems-water piping -cooling load -air conditioning systems for different types of buildings -protection against fire to be caused by A.C.Systems.

UNIT: V
Fire Systems
Causes of fire in buildings-safety regulations-NBC-planning considerations in buildings like Non-combustible materials, construction, staircases and A.C. systems, special features required for physically handicapped and elderly in building types-heat and smoke detectorsdry and wet risers-Automatic sprinklers - Capacity determination of OHT and UGT for fire fighting needs.
UNIT: VI
Intelligent buildings
Building automation-Smart buildings- Building services in high rise buildings.

Reference Books:
8. F. Hall (Author), Roger Greeno (Author), Building Services Handbook: Incorporating Current Building and Construction Regulations.
11. E.C. Butcher and A.C. Parnell., Designing for Fire safety
12. Peter R. Smith and Warden G. Julian, Building Services
STC 105 ELECTIVE: 1

A) STRUCTURAL INSTRUMENTATION & MATERIAL SCIENCE

Teaching scheme: 03 L+01 T=04          Credit: 04
Evaluation scheme: 20 IE+10 MSE+70 ESE  Total marks: 100
Duration of ESE: 3 Hrs.

Objective:
After studying this subject the student will be able to understand instrumentation and its application in structural engineering

UNIT: I
Study of various transducers & Principle of their working, displacement velocity acceleration.

UNIT: II
Stress-strain measurement, strain gauges static and dynamics strain measurement, Calculation of stresses from measurement of strain, deflections etc.

UNIT: III
Special materials for building constructions i. e. steel fibre reinforced concrete, fibre reinforced plastics.

UNIT: IV
Non-destructive testing of concrete / steel / ultrasonic techniques etc, model Analysis related to structures.

UNIT: V
Admixture for concrete, theories of corrosion and its preventions.

UNIT: VI
Special concrete like lightweight concrete, no fines concrete, Ferro cement, fly ash concrete etc. high performance concrete.

Text Book:
2. Instrumentation in Industry: Soisson, H. E. John Willey & Sons, NY, 1975

References Books:
B) COMPUTATIONAL TECHNIQUES

Teaching scheme: 03 L+01 T=04  
Evaluation scheme: 20 IE+10 MSE+70 ESE  
Duration of ESE: 3 Hrs.  
Credit: 04  
Total marks: 100

Objective:
At the end of the course the student will be able to
1. Get the knowledge of various numerical methods which are required in static and dynamic analysis of structures.
2. Develop computer programs for numerical methods for easier computations.

UNIT – I
Solution of algebraic and transcendental equation:
Regula Falsi Method, Newton-Raphson method, Development of Computer Program.

UNIT – II
Solution of linear algebraic equations:
Gauss elimination, Cholesky method, Given’s method, Householder’s method.

UNIT – III
Eigen values problems: Direct, Jacobi, Rutishauser’s LR method, QR method.

UNIT – IV
Initial & two point boundary value problem:
Euler’s, Runge-Kutta, Milne's Methods, Development of Computer Program.

UNIT – V
Numerical Integration:
Trapezoidal Method, Simpson’s Method, Gauss Quadrature, Development of Computer Program, Double and triple integration.

UNIT – VI
Direct Integration Methods:
Central difference method, Houbolt method, Newmark’s method, Wilson - θ method.

Text Books
STC 106 LAB PRACTICE: 1

MATRIX ANALYSIS OF STRUCTURES

Teaching scheme: 02P = 02  Credit: 02
Evaluation scheme: 25 TW + 25 P/OE  Total marks: 50

PRACTICALS:

Analysis of following structural elements by using commercial software

1. Continuous beam without sinking of support.
2. Continuous beam with sinking of support.
3. Plane truss.
4. Plane truss with inclined roller.
5. Plane truss with temperature effect and lack of fit.
6. Space truss.
7. Plane frame without axial deformation.
8. Plane frame with axial deformation.
10. Rigid jointed space frame.
COURSE OBJECTIVES
After completion of syllabus students will able to
1. Understand basic concepts of Finite Element Method.
2. Apply the Finite Element Method to solve the problems of Structural Analysis
3. Understand modeling techniques for analysis of structures

UNIT – I
Principles and discretization, Elements stiffness formulation based on direct and variational
techniques, Raleigh Ritz Method for Bar and Beam analysis.

UNIT – II
Shape functions, Finite Element Formulation using Cartesian Coordinates, Application to 1D
problems, Convergence criteria.

UNIT – III
Triangular and Rectangular element formulation using Cartesian Coordinates, Application to 2D
stress analysis.

UNIT – IV
Natural coordinates, Numerical integration, Isoparametric elements, Application to 1D Problems,
Isoparametric elements for two-dimensional stress analysis.

UNIT – V
Plate bending element based on classical and Mindlin plate theory, Formulation of stiffness
matrix for Mindlin thin and thick plates.

UNIT – VI
Modelling techniques, storage techniques and solution techniques

Text Books:
   Hall India, 1991
2. Rajasekaran S, Finite Element Analysis in Engineering Design, S. Chand
3. S.S. Bhavikatti - Finite Element Analysis – New Age International Publishers, Delhi

Reference Books:
2. Cook R. D. , Concepts and Applications of Finite Element Analysis, , 3rd Edition, Wiley India
   Textbooks, Wiley India Pvt Limited, New Delhi , 1989
   Publishing Co. Ltd
STC202  Structural Dynamics

Teaching scheme: 03 L+01 T=04  Credit: 04
Evaluation scheme: 20 IE+10 MSE+70 ESE  Total marks: 100
Duration of ESE: 3 Hrs.

COURSE OBJECTIVES
After completion of syllabus students will be able to,
1) Understand basic concepts of structural dynamics.
2) Calculate the response of buildings to dynamic loading.
3) Generate the response spectrum for dynamic loading.
4) Understand IS codes related to dynamic loading.

UNIT - I
Fundamentals of Rigid / Deformable body dynamics, Analysis of undamped and viscously damped single degree freedom systems.

UNIT - II
Response of single degree freedom systems to harmonic loading, support motion and transmissibility, Duhamel’s integral.

UNIT - III
Multiple degree of Freedom system: Vibration of undamped 2 DOF systems; Response of 2 DOF to harmonic excitation, mode superposition, vibration absorber, Lagrange equation and their application to lumped parameter models of MDOF (up to 3 DOF). Free vibration of MDOF (up to 3 DOF) systems, Dynamic response of MDOF (2 DOF) systems - modal superposition method

UNIT - IV
Dynamic analysis of systems with distributed properties, Approximate design method, Transformation factors.

UNIT - V
Response spectra, Introduction to vibrations due to earthquake, Study of IS 1893 applicable to Building and Water Tanks.

UNIT - VI

Text Books:
3. R.C. Roy - Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications

Reference Books:
1. Clough / Penzien, —Dynamics of Structures, McGraw Hill, 1993
2. Humar, J. L., —Dynamics of Structures, Prentice Hall, 1993
5. Damodarasamy and Kavitha, —Basics of structural Dynamics and Aseismic design, Phi Publisher, New Delhi.
COURSE OBJECTIVES
After completion of syllabus students will able to
1. Understand design of composite foundation systems of shallow foundations.
2. Understand design of deep foundation systems.
3. Analyze and understand various foundation failures.

UNIT – I
Design of different isolated and combined footings including eccentric loading,
Design of inverted arch foundation.

UNIT – II
Design of raft foundation.

UNIT – III
Design of deep foundation such as pile and well foundation.

UNIT – IV
Introduction to analysis and design of simple machine foundation.

UNIT – V
Theory of sub grade reaction, beam on elastic foundation, Concrete pavements.

UNIT – VI
Analysis and design of Abutments, Pier and Retaining walls.

Text Books:-
   House, New Delhi (2006)
4. Pillai S. V. and MenonD., Reinforced concrete Designl, TMH, New Delhi, 2009

Reference Books
   Delhi(2006)
   Delhi(2002)
   Hill, New Delhi (1982)
5. Ghosh, —Foundatios design in practicel, Phi Publisher, New Delhi
6. Som and Das, —Theory and Practice of Foundation Design, Phi Publisher, New Delhi
COURSE OBJECTIVES:
By understanding this subject the students will get versed with management techniques and advance technology in construction.

Unit:I
Understanding Project Management, Project manager, organization structures, organizing and staffing the project office and team
Management functions – directing, controlling, project authority, interpersonal influences, barriers, team building, communication, time management, conflicts
Construction Planning : Project planning, milestone schedules, WBS, Network techniques, CPM, PERT and Prima Vera, Resources leveling and smoothing.
Cost Control : Understanding control, operating cycles, cost account codes, Job cost report, Projected Cost Estimates, status reporting, variance and earned value

Unit:II
Concrete construction for heavy Engineering projects:-
Selection of equipments for batching, mixing, transporting, placing and compacting for various types of jobs, safety measures during concreting, special concretes and mortars, preplaced aggregate concrete, roller compacted concrete, concreting under water, concreting in different weather condition.

Unit:III
Method statement for large and heavy Engineering projects:-
Method statement for major activities like excavation, concreting, steel fabrication and erection for projects like earthen dams, tunnels, composite structure hydropower projects, nuclear power plant, refineries and other industrial projects like cooling tower, silos, and Chimney

Unit:IV
Road Project Equipment:
Automatic Paving Machine, Road Rollers, Asphalt plant, Batch Plants, Drum Mix Plants, Asphalt storage and heating, Haul truck, asphalt distributor, asphalt paver.

Bridge Construction: - Launching of bridges by incremental launching, using false work, and balanced cantilever construction method.

Unit:V
Ground Improvement Techniques:-
Soil distribution in India, Reclaimed Soils, selection for field compaction procedures, compaction quality control, stone column, sand drain, diaphragm wall, soil reinforcement, thermal methods, improving rock stability and quality.
Unit:VI
Formwork:
Requirement of formwork, loads carried by formwork, types of formwork such as timber formwork, Steel formwork, patent formwork, modular shuttering, slip forms, Vertical slip forming, Horizontal slip forming steelscaffolding.

References:

1. Thomas Baron, Erection of steel structures.
2. Stubbs, handbook of heavy Construction.
6. Dr. P. Purushothamma Raj, Ground Improvement Techniques, LaxmiPublicationsPunnoSwami, Bridge Construction
7. Journals of Civil Engineering and Construction Engineering
STC 205 Elective -II

A) Construction Contracts And Specification

Teaching scheme: 03 L+01 T=04  Credit: 04
Evaluation scheme: 20 IE+10 MSE+70 ESE  Total marks: 100
Duration of ESE: 3 Hrs.

COURSE OBJECTIVES
By studying this subject student will be aware of contractual obligation and legal provisions and arbitration.

Unit: I
Indian Contract Act 1872

Unit: II
Evaluation of Construction Contracts & Specifications, Contract Administration

Unit: III
Construction Claims, Laws affecting Engineers

Unit: IV
Contract Strategy & Management, Construction Disputes Settlement

Unit: V
Arbitration & Conciliation in India, Professional Practice Ethics, Duties & Responsibilities

Unit: VI
Construction Specifications- Standard Specifications, development, interpretation

Reference:
B) Advanced Design of Steel Structures

Teaching scheme: 03 L+01 T=04
Credit: 04
Evaluation scheme: 20 IE+10 MSE+70 ESE
Total marks: 100
Duration of ESE: 3 Hrs.

COURSE OBJECTIVES
At the end of the course student will be able to
1. Understand different types of loading with respect to structural parameters.
2. Application of IS code & SP code for detailing and drafting of different structural components.
3. Analysis and design of different types of structures.

UNIT – I

UNIT – II
Design of Steel Chimney

UNIT – III
Design of a truss Bridges, Design of plate girder bridges, Suspension bridges, Design of steel framework.

UNIT – IV
Design of storage Vessels, overhead pressed steel tanks, Plastic Analysis.

Text Books:
1. Pumia B.C. Comprehensive Design of steel structures, Laxmi publication ltd., 2000,
2. Duggal S.K., Design of Steel Structures, Mc Graw Hill publication, 2007

Reference:
4. Ghosh, — Analysis and Design practice of Steel Structurel, (Forthcoming), Phi Publisher, New Delhi
STC 206 LAB PRACTICE: II

Structural Dynamics And Instrumentation

Teaching scheme: 02P = 02 Credit: 02
Evaluation scheme: 25 TW + 25 P/OE Total marks: 50

PRACTICALS:

1. To study various instruments
2. Non Destructive Tests- Rebound Hammer and Ultra Sonic techniques, etc.
3. To study various instruments for the response of vibrating structure.
4. To study the response of a single degree of lumped mass system subjected to base excitation.
5. To study the response of a two degree of freedom system building frame subjected to base motion.
6. To study the response of a multi degree of lumped mass system.
7. Verification of natural frequency of SDOF model under free vibration.
8. To study the liquefaction of soil structure.
9. To study the Earthquake induced waves in rectangular water tank.
10. To calculate horizontal seismic force of building using IS-1893.
11. To calculate the lateral forces in water tank due to Earthquake when water tank is empty and watertank is full by IS-1893.

Any six from the above.
Objective:
After completion of syllabus students will able to
1. Understand the behavior of structures subjected to lateral loads.
2. Understand design aspects of RCC and Steel members subjected to earthquake loads.
3. Understand detailing of RCC and steel members for ductile behavior as per codal provisions.

UNIT – I
Earthquake, wind and other (i.e. blast, snow ) load calculations along with dead load and live loads and their combinations.

UNIT - II

UNIT - III
Capacity Design of RC Members, Design for Strong column & weak beam, Design of Beam-Column Joints.

UNIT - IV
Special aspects in Multi-story buildings, Effect of torsion, flexible first story, P-delta effect, soilstructure interaction on building response, drift limitation.

UNIT - V
Shear wall with ductile detailing. Preliminary sizing and Modeling of RC Buildings, Ductility and factors affecting ductility of RC members.

UNIT – VI

TEXT BOOKS:
2. Bruneau, M.; Uang, C.M.; & Whittaker, A Ductile Design of Steel Structures McGraw Hill.
3. Mazzolani, F.M.; & Piluso Theory and Design of Seismic Resistant Steel Frames E&FN Spon

Reference Books:
Objective:
By studying this subject students shall be aware of safety and precautions issues during quality construction

Unit:I
Total quality management concepts; ISO9000; QA/QC systems and organizations, National building Corle 2005

Unit:II
Quality Audits; Problem solving techniques; Statistical Quality Control; Quality Function Deployment.

Unit:III
Material Quality Assurance; Specifications and Tolerances.

Unit:IV
Safety issues; Injury accidents and their causes; Safety program components; Role of workers, Supervisors, Managers and Owners.

Unit:V
Safety Procedures for various construction operations; Safety audits; Safety laws.

Unit:VI
Safety Organization and Management: Safety policies, safety organization, safety committees, safety representatives, outside agencies – Govt. intervention, international agreements.

REFERENCE:
STC 303 LAB PRACTICE: III

Computer Aided Analysis

Teaching scheme: 02P = 02 Credit: 02
Evaluation scheme: 25 TW + 25 P/OE Total marks: 50

PRACTICALS:
1. Analysis and Design of Multistoried Building.
2. Analysis and Design of RCC Water Tanks.
3. Analysis and Design of RCC Bridge.
5. Analysis and Design of Bunkers and Silos.

Minimum four practicals to be performed (two from RCC and two from Steel)