St. PETER'S UNIVERSITY

St. Peter's Institute of Higher Education and Research
(Declared under section 3 of UGC Act 1956)
Avadi, Chennai – 600 054.

M.E (STRUCTURAL ENGINEERING) PROGRAMME

(I TO IV SEMESTERS)

REGULATIONS AND SYLLABI

(REGULATIONS – 2008)

M.E (STRUCTURAL ENGINEERING) PROGRAMME

Regulations and Syllabi

(Regulations 2008)

(Effective from 2008)

1. **Eligibility:** Candidates who passed B.E / B.Tech. (Civil engineering) B.E (Structural Engineering) of the University or A.M.I.E. in the concerned subject or any other equivalent examination thereto are eligible for admission to Two Year M.E. (Structural Engineering) Programme.

2. **Duration:** Two Years Comprising $ Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. **Medium:** English is the medium of instruction and examination.

4. **Weightage for Continuous and End Assessment:** The weightage for Continuous assessment (CA) and End Assessment (EA) be 25 : 75 unless the ratio is specifically mentioned in the scheme of Examinations.

5. **Credit System:** Credit system be followed with 18 credits for each semester and credit is equivalent to 25-30 hours of effective study provided in the Time Table.

6. **SCHEME OF EXAMINATION**

SEMESTER – I

Code No.	Course Title	CREDIT	Marks		
			CA	EA	Total
Theory					
108SEPT01	Applied Mathematics	3	25	75	100
108SEPT02	Experimental Methods and Model Analysis	3	25	75	100
108SEPT03	Structural Dynamics	3	25	75	100
108SEPT04	Constitutive Models and Modes of Failure	3	25	75	100
108SEPT05	**Elective I: Soil Structure Interaction**	3	25	75	100
108SEPT06	**Elective II : Prestressed Concrete**	3	25	75	100
	Total	**18**	**150**	**450**	**600**

SEMESTER – II

Code No.	Course Title	CREDIT	Marks		
			CA	EA	Total
Theory					
208SEPT01	Concrete Structures	3	25	75	100
208SEPT02	Design of Substructures	2	25	75	100
208SEPT03	Steel Structures	2	25	75	100
208SEPT04	Computational Methods	3	25	75	100
208SEPT05	**Elective III :Maintenance And Rehabilitation of Structures**	3	25	75	100
208SEPT06	**Elective IV: Stability of Structures**	3	25	75	100
Practical					
2**08**SEPP01	Structural Engineering Laboratory	2	25	75	100
	Total	**18**	**175**	**525**	**700**

SEMESTER – III

Code No.	Course Title	CREDIT	Marks		
			CA	EA	Total
Theory					
308SEPE02	**Elective V :**A seismic Design of Structures	3	25	75	100
308SEPE09	**Elective VI :** Industrial Structures	3	25	75	100
308SEPE08	**Elective VII :** Design of tall Buildings	3	25	75	100
Project					
308SEPP01	Project Work – Phase I*	9	25	65	100
	Viva voce			10	
	Total	**18**	**100**	**300**	**400**

***** Candidates who have completed Project work (Phase I) successfully are eligible for Project Work (Phase - II) Examination.

SEMESTER – IV

Code No.	Course Title	CREDIT	Marks		
			CA	EA	Total
Project					
408SEPP01	Project Work – Phase II*	18	25	65	100
	Viva voce			10	
	Total	**18**	**25**	**75**	**100**

LIST OF ELECTIVES FOR I to IV Semester

S.No	Electives	CREDIT
1	**Soil Structure Interaction(Elective I)**	3
2	**A seismic Design of Structures (Elective V)**	3
3	CAAD for Structures	3
4	Design of Bridges	3
5	Design of Plates, Shells and Spatial Structures	3
6	Design of Steel Concrete Composite Structures	3
7	Design of Structures for Dynamic Loads	3
8	**Design of Tall Buildings (Elective VII)**	3
9	**Industrial Structures (Elective VI)**	3
10	**Maintenance and Rehabilitation of Structures (Elective III)**	3
11	Optimization in Structural Design	3
12	**Prestressed Concrete (Elective II)**	3
13	**Stability of Structures (Elective IV)**	3
14	Wind and Cyclone effects on Structures	3

7. Passing Requirements: The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it is specifically mentioned in the Scheme of Examination.

8. Grading System: Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

= $\frac{\sum (CA+EA)\, C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

= (CA+EA)C

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. Pattern of the Question Paper: The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus). Each question carries 2 marks.

Part B: 5 questions with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks. The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

10. Effective Period of Operation for the Arrear Candidates : Two Year grace period is provided for the candidates to complete the arrear examination, if any.

Registrar

11. Syllabus

108SEPT01 - APPLIED MATHEMATICS

Unit I CALCULUS OF VARIATION

Introduction – Euler's equation – several dependent variables Lagrange's equation of Dynamics – Integrals involving derivatives higher that the First – Problem with constrains – Direct methods and eigen value problems.

Unit II MATRIX THEORY

Eigen values using QR transformations – generalized eigenvectors – canonical forms –singular value decomposition and application – Pseudo inverse – least square approximations.

Unit III LINEAR PROGRAMMING PROBLEM

Graphical method– simplex method – Big M Technique –Integer Programming.

Unit IV ONE DIMENSIONAL WAVE AND HEAT EQUATION

Laplace Transforms method for one – Dimensional Wave equation – Displacements in a line string – Longitudinal vibration of an elastic bar – Fourier Transform Methods for time dimensional Heat conduction problems in infinite rods.

Unit V ELLIPTIC EQUATION

Laplace equation – Properties of harmonic functions – Solution of Laplace's equation by means of Fourier transforms in a half plane, in an infinite strip and semi- infinite strip – Solution of poisson equation by Fourier transformer method.

REFERENCES:

1. Taha H.A. "Operation Research – An Introduction", Prenite Hall of India. 2001
2. K.H. Rosen , Discrete Mathematics and its Applications , Mc- Graw Hill Book Company, 1999
3. Broson .R. Matrix operations , Schaum's outline series McGraw Hill , New York , 1989
4. Gupta A.S Calculus of Variations with Applications, Prentice – Hal of India New Delhi , 1997
5. Sankara Rao , K. Introduction to partial Differential Equations , Prentice – Hall of India, New Delhi, 1995

108SEPT02 - EXPERIMENTAL METHODS AND MODEL ANALYSIS

Unit I Basic Concept in Measurements, Measurement of displacement, strain pressure, force, torque etc, Type of strain gauges (Mechanical, Electrical resistance, Acoustical etc..).

UNIT II Strain gauge circuits – The potentiometer and Wheatstone bridge – use of lead wires switches etc. Use of electrical resistance strain gauges in transducer applications.

UNIT III Indicating and recording devices - Static and dynamic data recording –Data (Digital and Analogue) acquisition and processing systems. Strain analysis methods – Rosette analysis. Static and dynamic testing techniques. Equipment for loading-Moire's techniques.

UNIT IV Non destructive testing techniques. Photoelasticity – optics of photoelasticity – Polariscope – Isoclinics and Isochromatics - methods of stress separation.

Unit V Laws of similitude - model materials – model testing – testing large scale structures – holographic techniques

TEXT BOOKS:

1. Dally J W and Riley W.F, Experimental stress Analysis, McGraw-Hill,
2. Inc. New York, 1991.
3. Srinath L S et al, Experimental Stress Analysis, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1984.

REFERENCES:

1. Rangan C S et al., Instrumentation – Devices and Systems, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1983.
2. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.

108SEPT03 - STRUCTURAL DYNAMICS

Unit I SINGLE DEGREE OF FREEDOM SYSTEMS
Formulation of equation of motion, Free and forced vibrations, Response to dynamic loading, Effect of damping.

Unit II MODAL ANALYSIS
Free and forced vibration of undamped and damped MDOF systems. Equation of motions, Evaluation of natural frequencies and mode shapes, Approximate methods, Mode superposition method, Numerical integration procedures

Unit III CONTINUOUS SYSTEMS
Dynamics of distributed parameter systems, Free and forced vibration of flexural beams, shear beams and columns.

Unit IV TRANSIENT AND DYNAMIC RESPONSE OF STRUCTURES
Idealisation of structures to mathematical models, Mode superposition method, Numerical integration procedures

UNIT V RANDOM AND STOCHASTIC VIBRATION
Random Variables and random processes, Models of random dynamic loads, Stochastic response of SDOF systems.

TEXT BOOKS :

1. Clough R.W, and Penzien J, Dynamics of Structures, Second Edition, McGraw-Hill International Edition, 1993
2. Mario Paz, Structural Dynamics – Theory and Computations, Third Edition, CBS publishers, 1990.

REFERENCES:

1. Roy R Craig, Structural Dynamics – An Introduction to Computer Methods, John Wiley and Sons, 1981.
2. Anderson R.A, Fundamentals of Vibration, Amerind Publishing Co., 1972.
3. Humar J L Dynamics of Structures, Prentice Hall, 1990.
4. Smith J W, Vibration of Structures – Application in Civil Engineering. Design Chapmat Hill 1988.

108SEPT04 - CONSTITUTIVE MODELS AND MODES OF FAILURE

Unit I ELASTICITY

Stress strain analysis – 2D problems – Cartesian and polar coordinates – generalized Hooke's law – 3D problems – energy relations

Unit II PLASTICITY

Yielding and yield surface – strain rates and failure theories – flow rule – elastic plastic and strain hardening models – beam and soil applications

Unit III MECHANICAL MODELS

Kelvin and Maxwell models – viscoelasticity – friction and Coloumb models – series, parallel and hybrid models – applications

Unit IV ENERGY RELATIONS

Work and energy types – energy theorems and material models – formulations Applications in beams and simple structures

Unit V APPLICATIONS

Engineering material models – steel and concrete – reinforced concrete- composites -one, two and three dimensional models – practical examples

REFERENCE BOOKS

1. Dowling, N.E., Mechanical Behaviour of Materials: Engineering Methods of Deformation, Fracture and Fatigue, 2nd Edition, Prentice – Hall, 1999.

2. Bedford, A.M. and Liechti, K.M., Mechanics of Materials, Prentice Hall, 2001.

3. Popov, E "Mechanics of Materials", Prentice Hall Reprinted Pearson Education, 2003.

108SEPT05 - SOIL STRUCTURE INTERACTION

Objective

The student is expected to understand the importance and significance of soil structure interaction and incorporate this in the design of structures to achieve both safety and economy.

UNIT I SOIL-FOUNDATION INTERACTION

Introduction to soil-foundation interaction problems – Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

UNIT II BEAM ON ELASTIC FOUNDATION- SOIL MODELS

Infinite beam, two parameters, Isotropic elastic half-space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT III PLATE ON ELASTIC MEDIUM

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, Simple solutions.

UNIT IV ELASTIC ANALYSIS OF PILE

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT V LATERALLY LOADED PILE

Load deflection prediction for laterally loaded piles, Sub grade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions through influence charts

REFERENCES:

1. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier, 1979

2. Poulos, H.G., and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley, 1980

3. Scott, R.F., "Foundation Analysis", Prentice Hall, 1981

4. "Structure-Soil Interaction - State of Art Report", Institution of Structural Engineers, 1978.

5. ACI 336, "Suggested Analysis and Design Procedures for combined footings and Mats", American Concrete Institute, Delhi, 1988

108SEPT06 - PRESTRESSED CONCRETE

OBJECTIVE

This course covers the principles analysis and design of prestressed concrete elements and other structures. In addition to the BIS codal provisions, ACI and British code, FIB specifications shall also be compared.

1. PRINCIPLES AND ANALYSIS FOR FLEXURE

Principles of Prestressing – Types of prestressing systems – Materials – Systems and devices – Analysis and design for flexure- Behaviour of prestressed concrete elements – General concept of prestress – Force transmitted by pretensioned and post tensioned systems - losses in prestress – analysis for Ultimate strength – Comparison of codal provisions - at service load and Magnel's approach .

2. DESIGN FOR FLEXURE

Concept of Limit State design – Limit state of Collapse and serviceability – Design using allowable stresses – Stress range approach - Lin's approach – Magnel's approach.

3. DESIGN FOR SHEAR, TORSION AND ANCHORAGE ZONE

Shear resistance in beams – Design for shear in rectangular and flanged beams – Behaviour under torsion –Modes of failure - Design for torsion, shear and bending Anchorage Zone – analysis and design of pretensioned and post tensioned end blocks - IS code provisions – Comparison of other codes.

4. STATICALLY INDETERMINATE STRUCTURES

Analysis of indeterminate structures – Continuous beams – Concept of concordance and linear transformations – Single storied rigid frames – Choice of cable profiles.

5. PSC SPECIAL STRUCTURES

Concept of circular prestressing – Design of prestressed concrete pipes and cylindrical water tanks - Composite construction- types, behaviour, flexural stresses, longitudinal shear transfer, transverse shear – Compression members – Design of poles and piles - Partial pre stressing – Principles, analysis and design concepts.

TEXT BOOKS

1. Prestressed Concrete by N.Rajagobalan, Norosa Publishing House (2002)
2. Prestressed Concrete by N.Krishnaraju, Tata McGraw-Hill Publishing Company 3rd Ed (1985)

REFERENCES

1. Design of Prestressed Concrete Structures by T.Y.Lin & Nedbhurns 3rd edition (1982), John Wiley & Sons
2. Fundamentals of Prestressed Concrete by N.C.Sinha & S.K.Roy, S.Chand & Co, New Delhi (1985)

SEMESTER – II

208SEPT01 - CONCRETE STRUCTURES

OBJECTIVE

This course covers the Advanced Design of Conventional and special elements of Reinforced Concrete Structures. At the end of the course the Student will acquire the Knowledge on the Behaviour, analysis and Design of RCC structures and also familiar with the usage of International standards.

1. DESIGN OF BEAMS

Behaviour of RCC beams under combined Shear Torsion and Bending-Modes of Failures-Inter action effects-Analysis and design of beams circular in plan and Spandrel beams-Design for Serviceability Limit states-Design calculation of deflections and crack width according to IS 456-2000

2. DESIGN OF SLENDER COLUMNS

Behaviour of slender RCC Columns- Failure modes and Interaction curves-Additional Moment method-Comparison of codal provisions- calculation of design moments for braced and unbraced columns-Principles of Moment magnification method-design of slender columns.

3. DESIGN OF SPECIAL RC ELEMENTS

Design and detailing of Concrete braced and unbraced walls according to BIS code—Classification of shear walls, design principles, design of rectangular and flanged shear walls-Analysis of forces, Design and detailing of Corbels-Design and detailing of Deep beams- and Approximate analysis and design of Grid floors.

4. DESIGN OF FLAT SLABS AND FLAT PLATES

Yield line theory of slabs - Hillerberg method of design of slabs- Design of Flat slabs and flat plates according to BIS method-Shear in Flat Slabs and Flat Plates

5. INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND FRAMES

Inelastic behaviour of concrete beams-moment-rotation curves-moment redistribution-Bakers method of analysis and design-Design of cast-in-situ joints in frames. Detailing requirements for ductility, durability and fire resistance

TEXT BOOKS

1. Varghese, P.C. "Advanced Reinforced Concrete Design", Prentice Hall of India, (2002).

2. Shah V.L., & Karve S.R. "Limit state theory and Design of Reinforced Concrete", Structures Publications, Pune (2003)

3. Krishna Raju, N., "Advanced Reinforced Concrete Design", CBS Publishers and Distributers, (1986)

4. Sinha.S.N., "Reinforced Concrete Design", Tata-McGraw-Hill (1996).

REFERENCES

1. Purushothaman, P, Reinforced Concrete Structure Structural Elements: Behaviour Analysis and Design, Tata McGraw-Hill, (1986).

2. Varghese, P.C. "Limit State Design of Reinforced Concrete", Prentice Hall of India, (2002).

3. Jack C. MCCormac., "Design of Reinforced Concrete", John Wiley &Sons(200)

4. Ramchandra & Virendra Gehlot., "Elements of Limit State Design of Concrete Structures" Scientific Publishers (India), (2004)

5. Arthur H.Nilson "Design of Concrete Structures", Tata McGraw-Hill,(2003)

1. Park. R, & Paulay .T, "Reinforced Concrete Structures", John Wiley & Sons (1975)

208SEPT02 - DESIGN OF SUBSTRUCTURES

OBJECTIVE:
At the end of the course, the student must have acquired a firm understanding of the practical design of foundations under different conditions.

1. SUB SURFACE EXPLORATION
Purpose - Programme and Procedures – Interpretation of bore logs, soil data and exploration reports.

2. SHALLOW FOUNDATIONS
Types of foundations and their specific applications – depth of foundation – bearing capacity and settlement estimates – structural design of isolated footings, strip, rectangular and trapezoidal combined footings – strap – balanced footings – raft foundation – Approximate flexible method of raft design - Compensated foundations.

3. DEEP FOUNDATIONS
Types of Piles and their applications - Load capacity - Settlements - Group action - Design of piles and pile caps – Lateral load capacity of piles.

4. FOUNDATIONS FOR BRIDGES AND OTHER MISCELLANEOUS STRUCTURES

Drilled shaft foundations and caissons for bridges - Foundations for towers – Chimneys – Silos – Structural Design of supports for foundation excavations – Design of Anchors.

5. MACHINE FOUNDATIONS
Types - General requirements and design criteria - General analysis of machine-foundations-soil system - Stiffness and damping parameters - Tests for design parameters - Guide lines for design of reciprocating engines, impact type machines, rotary type machines, framed foundations.

REFERENCE BOOKS:
1. Thomlinson, M.J. and Boorman. R. "Foundation Design and Construction", ELBS Longman VI edition, 1995.
2. Nayak, N.V., "Foundation Design manual for Practicing Engineers", Dhanpat Rai and Sons, 1982.
3. Winterkorn H.F., and Fang H.Y., "Foundation Engineering Hand Book - Van Nostrard - Reinhold - 1976.
4. Brain J Bell and M.J. Smith "Reinforced Concrete Foundations" George Godwin Ltd.
5. Braja M. Das "Principles of Foundations Engineering" Thomson Asia (P) Ltd.
6. Bowels J. E "Foundation Analysis and Design" McGraw-Hill International Book Co.

208SEPT03 - STEEL STUCTURES

OBJECTIVE:
This course covers the design of steel structures as per the current codal provisions and the revised draft code. An Introductory unit on Limit state Design is also included. At the end of the course the student will be in a position to Design the Steel structures.

1. ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS
Review of loads on structures-Dead, Live, wind and Seismic loads as per National standard-Analysis and Design of Industrial buildings and bents-Sway and non-sway frames- Design of Purlins, lovuver rails, gable column and Gable wind girder-Analysis and design of Gable frames.

2. BEHAVIOUR AND DESIGN OF CONNECTIONS
Connection behaviour -Design requirements of Bolted and welded connections- unsiffened and stiffened seat connections –framed connections- Connections for force and moment transmission-tee stub and end plate connections- Column stiffeners and other reinforcement-principles of semi rigid connections.

3. ANALYSIS AND DESIGN OF COLD-FORMED STEEL STRUCTURES
Types of cross sections-concepts of local buckling, and Effective width-Design of compression and tension members,- concepts of lateral buckling –Design of Beams, deflections of beams and design of beam webs.- Combined stresses and connections-Empirical design of Z-purlins with lips and wall studs.

4. ANALYSIS AND DESIGN OF SPECIAL STRUCTURES
Analysis and design of Steel Water Tanks- Cylindrical and pressed steel tanks -Design of self supporting Chimney (lined and unlined) and Guyed steel stacks-Stresses due to wind and earthquake forces-Design of foundations along with loads calculation- Gust Factor Method.

5. ADVANCED DESIGN PHILOSOPHIES
Concepts of Plastic design – Probabilistic basis of Load and Resistance Factors-LRFD –Limit State Design –Ultimate and serviceability limit states-Limit State Design of Axially loaded members – Design of beams.

TEXT BOOKS:

1. P.Dayaratnam, "Design of Steel Structures", Wheeler Publishing, (1990)
2. Teaching Resource for Structural Steel Design, INSDAG. Kolkotta (2001)
3. J.Rhodes, "Design of Cold-Formed Steel Members", Elsevier Science Publishers (1991)
4. S.Ramchandra, Design of Steel Structures, Vol.-II, Standard Publication, New Delhi.

REFERENCES

1. Horne, M.R., and Morris, L.J., Plastic "Design of Low rise frames", Granada Publishing Ltd., 1981.
2. Salmon, C, G., and Johnson, J.E. "Steel Structures-Design and Behaviour, Harper and Row, 1980.
3. Robert Englekirk, "Steel Structures – Controlling Behaviour Through Design", John Wiley & Sons
4. Kuzamanovic, B.O.and Williems, N, "Steel Design for Structural Engineers", Prentice Hall, (1977)
5. Wie-Wen Yu., "Cold-formed Steel Structures", McGraw-Hill Book Company, 1973
6. William McGuire, "Steel Structures", Prentice Hall, Inc., Englewood cliffs, N.J.1986.
7. Arthur R. Thamboli, "Steel Design Hand Book-LFRD Method" McGraw-Hill (1997)
8. William T. Segui "LFRD Steel Design" PWS Publishing

208SEPT04 - COMPUTATIONAL METHODS

1. MODELLING

Engineering design cycle – modeling types – dimensional and analytical models – numerical and design models – computer-based modeling- examples

2. MATRIX METHODS

Force and displacement methods – relation with energy – stiffness and flexibility solution of equations – beam, truss and frame applications

3. LINEAR ANALYSIS

Performance of structural systems – load-deflection – moment-rotation – linearity Discretisation by finite elements – assembly and solution – applications using Software- pre and post processor interpretations

4. NON-LINEAR ANALYSIS

Definition – geometric and material nonlinearity – strain displacement – stress- strain – finite element format – software usage for large deflection – software for inelastic behaviour.

5. DYNAMIC ANALYSIS

Mass and damping in time dependent structural response – basic equations – eigenvalues and eigenvectors **–** modal methods – integration methods –software usage

REFERENCE BOOKS

1. Rao, S.S., Applied Numerical Methods for Scientists and Engineers, Pearson Higher Education, 2001.
2. Rao, S.S., The Finite Element Method in Engineering, Pergamon Press, 1999.
3. Bathe, K.J., Finite Element Procedures in Engineering Analysis, Prentice Hall, 1995.
4. Moaveni, S., Finite Element Analysis – Theory and Application, Prentice Hall, 1999.
5. P.Seshu, Finite Element Analysis, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.

208SEPT05 - MAINTENANCE AND REHABILITATION OF STRUCTURES

1. GENERAL
Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking.

2. INFLUENCE ON SERVICEBILITY 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, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

3. MAINTENANCE AND REPAIR STRATEGIES
Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

4. MATERIALS FOR REPAIR
Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

5. TECHNIQUES FOR REPAIR
Rust eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning.

6. EXAMPLES OF REPAIR TO STRUCTURES
Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure.

7. Engineered demolition techniques for Dilapilated structures - case studies

TEXT BOOKS:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures", Materials, Maintenance and Repair, Longman Scientific and Technical UK, 1991.
2. R.T.Allen and S.C.Edwards, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.

208SEPT06 - STABILITY OF STRUCTURES

OBJECTIVE

This course covers the behaviour of structural elements under compressive loads. The stability of columns beams and plates under various load condition. An introduction to numerical techniques is also included.

1. STABILITY OF COLUMNS

Concepts of Elastic Structural stability- Analytical approaches to stability - characteristics of stability analysis- Elastic Buckling of columns- Equilibrium; Energy and Imperfection approaches – Non-prismatic columns- Built up colyumns- orthogonality of buckling modes- Effect of shear on buckling load - Large deflection theory.

2. METHODS OF ANALYSIS AND IN ELASTIC BUCKLING

Approximate methods – Rayleigh and Galerkin methods – numerical methods – Finite difference and finite Element - analysis of columns – Experimental study of column behaviour – South well plot - Column curves - Derivation of Column design formula - Effective length of Columns - Inelastic behaviour- Tangent modulus and Double modulus Theory

3. BEAM COLUMNS AND FRAMES

Beam column behaviour- standard cases- Continuous columns and beam columns – Column on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Approximate evaluation of critical loads in multistoried frames – Use of Wood's charts.

4. BUCKLING OF BEAMS

Lateral buckling of beams – Energy method- Application to Symmetric and simply symmetric I beams – simply supported and Cantilever beams - Narrow rectangular cross sections- – Numerical solutions – Torsional buckling – Uniform and non uniform Torsion on open cross section - Flexural torsional buckling – Equilibrium and energy approach.

5. BUCKLING OF THIN PLATES

Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges – Use of Energy methods – Plates with stiffeners – Numerical Techniques.

TEXT BOOKS:

1. Ashwini kumar, "Stability of Structures", Allied Publishers Ltd, (1998)
2. NGR Iyengar, "Structural Stability of Columns and Plates" Affiliated East- West Press Pvt. Ltd (1986)
3. Stephen P. Timoshenko and Gere "Theory of Elastic stability", McGraw-Hill Company (1963)

REFERENCES

1. Allen, H.G and Bulson, P.S., Background to Buckling McGraw-Hill Book Company, 1980
2. Smitses, Elastic Stability of Structures, Prentice Hall, 1973
3. Brush and Almorth, Buckling of Bars, plates and shells, McGraw-Hill Book Company, 1975.
4. Chajes, A. Principles of Structures Stability Theory, Prentice Hall 1974.

208SEPP01 - STRUCTURAL ENGINEERING LABORATORY

1. Concrete mix design - Properties of fresh and hardened concrete
2. Strain gauges – Principles and applications, mechanical, optical and electrical strain gauges, Strain recording instruments.
3. Study the constitutive behaviour of structural materials (concrete and steel)
4. Study the response of structural members (RC columns, beams) using accelerometers, load cells etc.
5. Use of static and dynamic data recording and processing systems.

REFERENCES

1. Dally J W, and Riley W F, "Experimental Stress Analysis", McGraw-Hill, Inc. New York, 1991.

III SEMESTER

308SEPE02 - A SEISMIC DESIGN OF STRUCTURES

1. Elements of Engineering Seismology - Characteristics of Earthquakes - History - Seismic Susceptibilty of Indian Subcontinent - Performance of structures under past earthquakes, Lessons learnt from past earthquakes.

2. Building Systems – Rigid Frames, Braced Frames, Shear Walls - Behaviour of RC, steel and prestressed concrete elements under cyclic loading - Soil performance.

3. Concept of Earthquake Resistant Design - Provisions of Seismic Code IS 1893 (Part I) – 2002 - Response Spectrum - Design Spectrum - Structural Configuration - 3 D computer analysis of building (Theory) - Design and Detailing of Frames, Shear Walls and Framed Walls – Provisions of IS-13920.

4. Design of Non Engineered construction - strengthening of buildings - Design Provisions for Bridges and Dams.

5. Modern Concepts – Base Isolation – Adoptive systems – Case studies.

TEXT BOOKS:

1. Course Notes "Design of Reinforced Concrete Buildings", IIT Kanpur, June, 1999 (NPEEE publication).
2. Minoru Wakabayashi, "Design of Earthquake Resistant Buildings", McGraw – Hill Book Company, New York, 1986

REFERENCES:

1. Anil K Chopra, "Dynamics of structures – Theory and applications to Earthquake Engineering", Prentice Hall Inc., 2001.
2. Norman B Green, "Earthquake Resistant Building Design and Construction", Elsevier Science Publishing Co. Inc., New York, 1987

308SEPE08 DESIGN OF TALL BUILDINGS

1. DESIGN CRITERIA
Design Philosophy, Materials – Modern concepts – High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self Compacting Concrete.

2. LOADING
Gravity Loading – Dead load, Live load, Impact load, Construction load, Sequential loading.
Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods.
Earthquake Loading – Equivalent lateral Load analysis, Response Spectrum Method, Combination of Loads,

3. BEHAVIOUR OF STRUCTURAL SYSTEMS
Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, In filled frames, Shear walls, Coupled Shear walls, Wall – Frames, Tubular, Outrigger braced, Hybrid systems.

4. ANALYSIS AND DESIGN
Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of structures as an integral unit, Analysis for member forces, drift and twist. Computerized 3D analysis.

Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance.

5. STABILITY ANALYSIS
Overall buckling analysis of frames, wall – frames, Approximate methods, Second order effect of gravity loading, P – Delta Effects, Simultaneous first order and P-Delta analysis, Translational instability, Torsional Instability, Out of plumb effects, Effect of stiffness of members and foundation rotation in stability of structures.

TEXT BOOKS:
1. Bryan Stafford Smith and Alex Coull, "Tall Building Structures", Analysis and Design, John Wiley and Sons, Inc., 1991.
2. Taranath B.S, "Structural Analysis and Design of Tall Buildings", McGraw-Hill, 1988

REFERENCES:
1. COULL, A. and SMITH, STAFFORD, B. "Tall Buildings", Pergamon Press, London, 1997.
2. LinT.Y. and Burry D.Stotes, "Structural Concepts and Systems for Architects and Engineers", John Wiley, 1994.
3. Lynn S.Beedle, Advances in Tall Buildings, CBS Publishers and Distributors, Delhi, 1996.

308SEPE09 - INDUSTRIAL STRUCTURES

OBJECTIVE

The course introduces planning, functional requirements, analysis and design of Industrial, Buildings, Power Plant structures and transmission structures. At the end of the course the student shall acquires knowledge pertaining to overall aspects of industrial/power plant structures.

1. PLANNING AND FUNCTIONAL REQUIREMENTS

Classification of Industries and Industrial structures – planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety – Protection against noise and vibration – Guidelines from Factories Act.

2. INDUSTRIAL BUILDINGS

Roofs for Industrial Buildings – Steel and RC – Folded Plates and Shell Roofs – Gantry Girders – Design of Corbels and Nibs – Machine Foundations.

3. POWER PLANT STRUCTURES

Bunkers and Silos – Chimney and Cooling Towers – Design of Steel storage tanks – Nuclear containment structures.

4. POWER TRANSMISSION STRUCTURES

Cables – Transmission Line Towers – Substation structures – Tower foundations – Testing towers.

REFERENCES:

1. Procs. of advanced course on Industrial Structures, Structural Engineering Research Centre, 1982.
2. P.Srinivasulu and C.V. Vaidyanathan, Handbook of Machine Foundations, Tata McGraw-Hill 1976.
3. S.N. Manohar, Tall Chimneys – Design and Construction, Tata McGraw-Hill, 1985.
4. A.R. Santhakumar and S.S. Murthy, Transmision Line Structures, Tata McGraw-Hill 1992.
5. Dr. K. Rajagopalan – Storage Structures – Oxford IBH Publishing Company Ltd. 1989.

ELECTIVES

SOIL STRUCTURE INTERACTION

The student is expected to understand the importance and significance of soil structure interaction and incorporate this in the design of structures to achieve both safety and economy.

1. SOIL-FOUNDATION INTERACTION

Introduction to soil-foundation interaction problems – Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

2. BEAM ON ELASTIC FOUNDATION- SOIL MODELS

Infinite beam, two parameters, Isotropic elastic half-space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

3. PLATE ON ELASTIC MEDIUM

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, Simple solutions.

4. ELASTIC ANALYSIS OF PILE

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

5. LATERALLY LOADED PILE

Load deflection prediction for laterally loaded piles, Sub grade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions through influence charts

REFERENCES:

1. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier, 1979

2. Poulos, H.G., and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley, 1980

3. Scott, R.F., "Foundation Analysis", Prentice Hall, 1981

4. "Structure-Soil Interaction - State of Art Report", Institution of Structural Engineers, 1978.

5. ACI 336, "Suggested Analysis and Design Procedures for combined footings and Mats", American Concrete Institute, Delhi, 1988

A SEISMIC DESIGN OF STRUCTURES

1. Elements of Engineering Seismology - Characteristics of Earthquakes - History - Seismic Susceptibilty of Indian Subcontinent - Performance of structures under past earthquakes, Lessons learnt from past earthquakes.

2. Building Systems – Rigid Frames, Braced Frames, Shear Walls - Behaviour of RC, steel and prestressed concrete elements under cyclic loading - Soil performance.

3. Concept of Earthquake Resistant Design - Provisions of Seismic Code IS 1893 (Part I) – 2002 - Response Spectrum - Design Spectrum - Structural Configuration - 3 D computer analysis of building (Theory) - Design and Detailing of Frames, Shear Walls and Framed Walls – Provisions of IS-13920.

4. Design of Non Engineered construction - strengthening of buildings - Design Provisions for Bridges and Dams.

5. Modern Concepts – Base Isolation – Adoptive systems – Case studies.

TEXT BOOKS:

1. Course Notes "Design of Reinforced Concrete Buildings", IIT Kanpur, June, 1999 (NPEEE publication).
2. Minoru Wakabayashi, "Design of Earthquake Resistant Buildings", McGraw – Hill Book Company, New York, 1986

REFERENCES:

1. Anil K Chopra, "Dynamics of structures – Theory and applications to Earthquake Engineering", Prentice Hall Inc., 2001.
2. Norman B Green, "Earthquake Resistant Building Design and Construction", Elsevier Science Publishing Co. Inc., New York, 1987

CAAD FOR STRUCTURES

1. COMPUTER GRAPHICS

Graphic primitives - Transformations - Basics of 2-D drafting - Modeling of curves and surfaces – Solid modeling - Graphic standards - Drafting software packages and usage.

2. STRUCTURAL ANALYSIS

Computer methods of structural analysis - Finite Element programming - Analysis through application packages.

3. STRUCTURAL DESIGN

Computer aided design of steel and RC Structural elements - Detailed drawing - Bill of materials.

4. OPTIMIZATION

Linear programming - Simplex algorithm - Post-optimality analysis - Project scheduling - CPM and PERT applications Genetic algorithm and applications.

5. ARTIFICIAL INTELLIGENCE

Introduction - Heuristic search - knowledge based expert systems - Architecture and applications of KBES - Expert system shells - Principles of neural network.

REFERENCES:

1. C.S. Krishnamoorthy and S.Rajeev, Computer Aided Design, Narosa Publishing House, New Delhi, 1991.

2. H.B. Harrison, Structural Analysis and Design Vol. I & II, Pergamon Press, 1991 E.Hinton and D.R.J.Owen, Finite Element Programming, Academic Press 1977.

3. Billy E.Gillet, Introduction to Operations Research, A computer oriented algorithmic approach, Tata McGraw-Hill 1982.

4. Richard Forsyth (Ed.), Expert System Principles and Case studies - Chapman & Hall.

DESIGN OF BRIDGES

1. INTRODUCTION

Classification, investigations and planning, choice of type, I.R.C.specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

2. SHORT SPAN BRIDGES

Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges.

3. LONG SPAN GIRDER BRIDGES

Design principles of continuous bridges, box girder bridges, balanced cantilever bridges.

4. DESIGN OF PRESTRESSED CONCRETEBBRIDGES

5. DESIGN OF PLATE GRIDER BRIDGES

6. BEARINGS, SUBSTRUCTURES AND FOOTINGS FOR BRIDGES

REFERENCES:

1. Raina V.K. "Concrete Bridge Practice", Tata McGraw-Hill Publishing Company, New Delhi, 1991.

2. Krishnaraju, N., "Design of Bridges", Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 1988

3. Bakht, B. and Jaegar, L.G., "Bridge Analysis Simplified", McGraw-Hill, 1985.

4. Ponnuswamy, S., "Bridge Engineering", Tata McGraw-Hill, 1989

5. Derrick Beckett, "An introduction to Structural Design of Concrete Bridges", Surrey University Press, Henley Thomes, Oxford Shire, 1973.

6. Taylor, F.W., Thomson, S.E., and Smulski E., "Reinforced Concrete Bridges", John Wiley and Sons, New York, 1955.

7. Edwin H.Gaylord Jr., Charles N.Gaylord, James, E., Stallmeyer "Design of Steel Structures" McGraw-Hill International Editions, 1992.

DESIGN OF PLATES, SHELLS AND SPATIAL STRUCTURES

OBJECTIVE

The course introduces Analysis and Design of Plates, Shells and space structures.
At the end of the course student shall acquire hands on experience to conceive structural configuration comprising of above systems for various applications in Civil Engineering

1. Equation of equilibrium and deformation of plates – Bending of rectangular plates and circular plates.

2. Energy method, finite difference and finite element methods for solution of plate bending problems. Principles of design of folded plates

3. Geometry of shells – Classification of Shells – membrane theory of circular and cylindrical shells – Detailed Analysis and design of cylindrical shells – Detailing of Reinforcement in shells, edge beams and transfer beam

4. Space frames – configuration – types of nodes – general principles of design Philosophy – Behaviour.

5. Analysis of space frames – Formex Algebra, FOR MAIN – detailed design of space frames.

REFERENCES:

1. Wilhelm Flugge, stresses in shells, springer – Verlag
2. Timoshenko, S. Theory of plates and Shells, McGraw-Hill, 1990
3. Ramasamy, G.S. Design and Construction of Concrete shells roofs, CBS Publishers, 1986
4. Principles of space structures by Dr.N. Subramanian – 1999, Wheeler Publishing Co.
5. Proceedings of International Conference on Space structures, Anna University, November 1997.
6. Szllard, R. Theory of Analysis of Plates, Prentice Hall Inc.

DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

1. INTRODUCTION

Introduction to steel - Concrete composite construction - Theory of composite structures - Introduction to steel - Concrete - Steel sandwich construction.

2. DESIGN OF COMPOSITE MEMBERS

Behaviour of composite beams - Columns - Design of composite beams - Steel - Concrete composite columns - Design of composite trusses.

3. DESIGN OF CONNECTIONS

Types of connections - Design of connections in the composite structures - Shear connections - Design of connections in composite trusses.

4. COMPOSITE BOX GRIDER BRIDGERS

Introduction - Behaviour of box girder bridges - Design concepts.

5. GENERAL

Case studies on steel - Concrete composite construction in buildings - Seismic behaviour of composite structures.

REFERENCES:

1. Johnson R.P., Composite Structures of steel and concrete, Blackwell Scientific Publications (Second Edition), UK, 1994.

2. Owens, G.W. and Knowels. P. Steel Designers manual (Fifth edition), Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992.

3. Workshop on Steel Concrete Composite Structures, conducted at Anna University, 2000.

DESIGN OF STRUCTURES FOR DYNAMIC LOADS

1. INTRODUCTION

Factors affecting design against dynamic loads - Behaviour of concrete, steel, masonry and soil under impact and cyclic loads - Recap of Structural dynamics with reference to SDOF, MDOF and continuum systems - Ductility and its importance.

2. DESIGN AGAINST EARTHQUAKES

Earthquake characterisation - Response spectra - seismic coeffcient and response spectra methods of estimating loads - Response of framed, braced frames and shear wall buildings - Design as per BIS codes of practice - Ductility based design.

3. DESIGN AGAINST BLAST AND IMPACT

Characteristics of internal and external blast - Impact and impulse loads - Pressure distribution on buildings above ground due to external blast - underground explosion - Design of bulidings for blast and impact as per BIS codes of practice.

4. DESIGN AGAINST WIND

Characteristics of wind - Basic and Design wind speeds - Effect of premeability of the structure – pressure coefficient - Aeroelastic and Aerodynamic effects - Design as per BIS code of practice including Gust Factor approach - tall buildings, stacks and chimneys.

5. SPECIAL CONSIDERATIONS

Energy absorption capacity – Ductility of the material and the structure – Detailing for ductility – Passive and active control of vibrations – New and favourable materials.

REFERENCES:

1. Bela Goschy, "Design of Building to withstand abnormal loading", Butterworths, 1990.

2. Paulay, T. and Priestly, M.N.J., "A seismic Design of Reinforced Concrete and Masonry building", John Wiley and Sons, 1991.

3. Dowling, C.H., "Blast vibration - Monitoring and Control", Prentice Hall Inc., Englewood Cliffs, 1985.

4. Kolousek, .V. et al., "Wind effects on Civil Engineering Structures", Elsevier, 1984.

5. Concrete Structures under Impact and Impulsive Loading, Synthesis Report CEB,Lousanne, Germany, 1988.

DESIGN OF TALL BUILDINGS

1. DESIGN CRITERIA

Design Philosophy, Materials – Modern concepts – High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self Compacting Concrete.

2. LOADING

Gravity Loading – Dead load, Live load, Impact load, Construction load, Sequential loading.
Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods.
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4. ANALYSIS AND DESIGN

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1. Bryan Stafford Smith and Alex Coull, "Tall Building Structures", Analysis and Design, John Wiley and Sons, Inc., 1991.
2. Taranath B.S, "Structural Analysis and Design of Tall Buildings", McGraw-Hill, 1988

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1. COULL, A. and SMITH, STAFFORD, B. "Tall Buildings", Pergamon Press, London, 1997.
2. LinT.Y. and Burry D.Stotes, "Structural Concepts and Systems for Architects and Engineers", John Wiley, 1994.
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INDUSTRIAL STRUCTURES

OBJECTIVE

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1. PLANNING AND FUNCTIONAL REQUIREMENTS

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Bunkers and Silos – Chimney and Cooling Towers – Design of Steel storage tanks – Nuclear containment structures.

4. POWER TRANSMISSION STRUCTURES

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1. Procs. of advanced course on Industrial Structures, Structural Engineering Research Centre, 1982.
2. P.Srinivasulu and C.V. Vaidyanathan, Handbook of Machine Foundations, Tata McGraw-Hill 1976.
3. S.N. Manohar, Tall Chimneys – Design and Construction, Tata McGraw-Hill, 1985.
4. A.R. Santhakumar and S.S. Murthy, Transmision Line Structures, Tata McGraw-Hill 1992.
5. Dr. K. Rajagopalan – Storage Structures – Oxford IBH Publishing Company Ltd. 1989.

MAINTENANCE AND REHABILITATION OF STRUCTURES

1. GENERAL

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking.

2. INFLUENCE ON SERVICEBILITY 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, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

3. MAINTENANCE AND REPAIR STRATEGIES

Definitions : Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

4. MATERIALS FOR REPAIR

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

5. TECHNIQUES FOR REPAIR

Rust eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning.

6. EXAMPLES OF REPAIR TO STRUCTURES

Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure.

7. Engineered demolition techniques for Dilapilated structures - case studies

TEXT BOOKS:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures", Materials, Maintenance and Repair, Longman Scientific and Technical UK, 1991.

2. R.T.Allen and S.C.Edwards, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.

REFERENCES:

1. M.S.Shetty, "Concrete Technology - Theory and Practice", S.Chand and Company, New Delhi, 1992.

2. Santhakumar, A.R., "Training Course notes on Damage Assessment and repair in Low Cost Housing", "RHDC-NBO", Anna University, July, 1992.

3. Raikar, R.N., "Learning from failures - Deficiencies in Design", Construction and Service - R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

4. N.Palaniappan, "Estate Management, Anna Institute of Management", Chennai, 1992.

5. Lakshmipathy, Metal Lecture notes of Workshop on "Repairs and Rehabilitation of Structures", 29 - 30th October 1999.

OPTIMIZATION IN STRUCTURAL DESIGN

1. INTRODUCTION

Basic concepts of minimum weight, minimum cost design, Objective function, constraints, classical methods.

2. OPTIMIZATION TECHNIQUES AND ALGORITHMS

Linear programming, Integer Programming, Quadratic Programming, Dynamic Programming and Geometric Programming methods for Optimal design of structural elements.

3. COMPUTER SEARCH METHODS

Linear Programming methods for plastic design of frames, Computer search methods for univariate and multivariate Minimization.

4. OPTIMIZATION THEOREMS

Optimization by structural theorems, Maxwell, Mitchell and Heyman's Theorems for trusses and frames, fully stresses design with deflection constraints, optimality criterion methods.

REFERENCES:

1. Spunt, Optimum Structural Design, Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.

2. S.S.Rao, Optimization Theory and Applications, Wiley Eastern Limited, New Delhi, 1977.

3. Uri Krisch, Optimum Structural Design, McGraw-Hill Book Co. 1981.

4. Richard Bronson, Operation Research, Schaum's Outline Series, McGraw-Hill Book Co, Singapore, 1983.

PRESTRESSED CONCRETE

OBJECTIVE

This course covers the principles analysis and design of prestressed concrete elements and other structures. In addition to the BIS codal provisions, ACI and British code, FIB specifications shall also be compared.

1. PRINCIPLES AND ANALYSIS FOR FLEXURE

Principles of Prestressing – Types of prestressing systems – Materials – Systems and devices – Analysis and design for flexure- Behaviour of prestressed concrete elements – General concept of prestress – Force transmitted by pretensioned and post tensioned systems - losses in prestress – analysis for Ultimate strength – Comparison of codal provisions - at service load and Magnel's approach .

2. DESIGN FOR FLEXURE

Concept of Limit State design – Limit state of Collapse and serviceability – Design using allowable stresses – Stress range approach - Lin's approach – Magnel's approach.

3. DESIGN FOR SHEAR, TORSION AND ANCHORAGE ZONE

Shear resistance in beams – Design for shear in rectangular and flanged beams – Behaviour under torsion –Modes of failure - Design for torsion, shear and bending Anchorage Zone – analysis and design of pretensioned and post tensioned end blocks - IS code provisions – Comparison of other codes.

4. STATICALLY INDETERMINATE STRUCTURES

Analysis of indeterminate structures – Continuous beams – Concept of concordance and linear transformations – Single storied rigid frames – Choice of cable profiles.

5. PSC SPECIAL STRUCTURES

Concept of circular prestressing – Design of prestressed concrete pipes and cylindrical water tanks - Composite construction- types, behaviour, flexural stresses, longitudinal shear transfer, transverse shear – Compression members – Design of poles and piles - Partial pre stressing – Principles, analysis and design concepts

TEXT BOOKS

1. Prestressed Concrete by N.Rajagobalan, Norosa Publishing House (2002)
2. Prestressed Concrete by N.Krishnaraju, Tata McGraw-Hill Publishing Company 3rd Ed (1985)

REFERENCES

1. Design of Prestressed Concrete Structures by T.Y.Lin & Nedbhurns 3rd edition(1982), John Wiley & Sons
2. Fundamentals of Prestressed Concrete by N.C.Sinha & S.K.Roy, S.Chand & Co, New Delhi (1985)

STABILITY OF STRUCTURES

OBJECTIVE

This course covers the behaviour of structural elements under compressive loads. The stability of columns beams and plates under various load condition. An introduction to numerical techniques is also included.

STABILITY OF COLUMNS

Concepts of Elastic Structural stability- Analytical approaches to stability - characteristics of stability analysis- Elastic Buckling of columns- Equilibrium; Energy and Imperfection approaches – Non-prismatic columns- Built up colyumns- orthogonality of buckling modes- Effect of shear on buckling load - Large deflection theory.

METHODS OF ANALYSIS AND IN ELASTIC BUCKLING

Approximate methods – Rayleigh and Galerkin methods – numerical methods – Finite difference and finite Element - analysis of columns – Experimental study of column behaviour – South well plot - Column curves - Derivation of Column design formula - Effective length of Columns - Inelastic behaviour- Tangent modulus and Double modulus Theory

BEAM COLUMNS AND FRAMES

Beam column behaviour- standard cases- Continuous columns and beam columns – Column on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Approximate evaluation of critical loads in multistoried frames – Use of Wood's charts.

BUCKLING OF BEAMS

Lateral buckling of beams – Energy method- Application to Symmetric and simply symmetric I beams – simply supported and Cantilever beams - Narrow rectangular cross sections- – Numerical solutions – Torsional buckling – Uniform and non uniform Torsion on open cross section - Flexural torsional buckling – Equilibrium and energy approach.

BUCKLING OF THIN PLATES

Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges – Use of Energy methods – Plates with stiffeners – Numerical Techniques.

TEXT BOOKS:

1. Ashwini kumar, "Stability of Structures", Allied Publishers Ltd, (1998)
2. NGR Iyengar, "Structural Stability of Columns and Plates" Affiliated East- West Press Pvt. Ltd (1986)
3. Stephen P. Timoshenko and Gere "Theory of Elastic stability", McGraw-Hill Company (1963)

REFERENCES

1. Allen, H.G and Bulson, P.S., Background to Buckling McGraw-Hill Book Company, 1980
2. Smitses, Elastic Stability of Structures, Prentice Hall, 1973
3. Brush and Almorth, Buckling of Bars, plates and shells, McGraw-Hill Book Company, 1975.
4. Chajes, A. Principles of Structures Stability Theory, Prentice Hall 1974.

WIND AND CYCLONE EFFECTS ON STRUCTURES

1. INTRODUCTION

Introduction, Spectral studies, Gust factor, Wind velocity, Methods of measurements, variation of speed with height, shape factor, aspect ratio, drag effects.

2. WIND TUNNEL STUDIES

Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero-elastic models.

3. WIND EFFECT

Wind on structures, Rigid structures, Flexible structures, Static and Dynamic effects, Tall buildings, chimneys.

4. DESIGN PRINCIPLES

Application to design, IS 875 code method, Buildings, Chimneys, Roofs, Shelters.

5. CYCLONE AND DESIGN

Cyclone effect on structures, cladding design, window glass design.

TEXT BOOKS:

1. Cook.N.J., The Designer's Guide to Wind Loading of Building Structures, Butterworths, 1989.
2. Kolousek., et.al., Wind Effects on Civil Engineering Structures, Elsevier Publications, 1984.

REFERENCES:

1. Peter Sachs, Wind Forces in Engineering, Pergamon Press, New York, 1972.
2. Lawson T.V., Wind Effects on Building Vol. I and II, Applied Science Publishers, London, 1980.

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