Curriculum, Scheme of Examinations and Syllabi for M-Tech Degree Programme with effect from Academic Year 2012-2013

KANNUR UNIVERSITY

Faculty of Engineering

CIVIL ENGINEERING

M-Tech in

Computer Aided Structural Engineering

FIRST SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination		Credit
		L	T	P		Hrs	Marks	
CAS 101	Theory of Elasticity	3	-	-	50	3	100	3
CAS 102	Structural Dynamics	3	-	-	50	3	100	3
CAS 103	Advanced Theory and Design of Concrete Structures	3	-	-	50	3	100	3
CAS 104	Finite Element Method	3	-	-	50	3	100	3
CAS 105	Elective I	3	-	-	50	3	100	3
CAS 106	Elective II	3	-	-	50	3	100	3
CAS 107(P)	Computational and Stress Analysis Lab	-	-	2	50	3	100	2
CAS 108(P)	Seminar	-	-	2	50	-	-	2
TOTAL		**18**		**4**	**400**		**700**	**22**

ELECTIVE I

CAS 105 (A) Advanced Concrete Technology
CAS 105 (B) Modelling, Simulation and Computer Application
CAS 105 (C) Design of Steel Concrete Composite Structures
CAS 105 (D) Structural Reliability

ELECTIVE II

CAS 106 (A) Design of Bridges
CAS 106 (B) Industrial Structures
CAS 106 (C) Forensic Engineering and Rehabilitation of Structures
CAS 106 (D) Mechanics of Composite Materials

Sessional marks for all the Theory based Subjects

The marks allotted for internal continuous assessment and end-semester university examinations shall be 50 marks and 100 marks respectively with a maximum of 150 marks for each theory subject.

The weightage to award internal assessment marks should be as follows:

Test papers (two tests) : 25 marks

Assignments and/or class performance : 25 marks

SECOND SEMESTER

Code	Subject	Hours/Week			Sessional Marks	University Examination		Credit
		L	T	P		Hrs	Marks	
CAS 201	Advanced Prestressed Concrete Design	3	-	-	50	3	100	3
CAS 202	Theory of Plates and Shells	3	-	-	50	3	100	3
CAS 203	Advanced Metal Structures	3	-	-	50	3	100	3
CAS 204	Elective III	3	-	-	50	3	100	3
CAS 205	Elective IV	3	-	-	50	3	100	3
CAS 206	Elective V	3	-	-	50	3	100	3
CAS 207(P)	Structural Engineering Design Studio	-	-	2	50	3	100	2
CAS 208(P)	Term Paper	-	-	2	50	3	100	2
TOTAL		**18**		**4**	**400**		**800**	**22**

ELECTIVE III

CAS 204 (A) Offshore Structures
CAS 204 (B) Optimisation of Structures
CAS 204 (C) Prefabricated Structures
CAS 204 (D) Design of Tall Buildings

ELECTIVE IV

CAS 205 (A) Construction Project Management
CAS 205 (B) Structural Health Monitoring
CAS 205 (C) Geographic Information System and Applications
CAS 205 (D) Advanced Design of Foundation
CAS 205 (E) Advanced Finite Element Analysis

ELECTIVE V

CAS 206 (A) Stability of Structures
CAS 206 (B) Earthquake Analysis and Design of Structures
CAS 206 (C) Wind and Cyclone Effects on Structures
CAS 206 (D) Theory of Plasticity

THIRD SEMESTER

Code	Subject	Hrs / Week			Marks					Credits
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
CAS 301 (P)	Thesis Preliminary			22	200	200	--	--	400	8
	Total			**22**	**200**	**200**			**400**	**8**

THESIS PRELIMINARY

This shall comprise of two seminars and submission of an interim thesis report. This report shall be evaluated by the evaluation committee. The fourth semester Thesis- Final shall be an extension of this work in the same area. The first seminar would highlight the topic, objectives, methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is presentation of the interim thesis report of the work completed and scope of the work which is to be accomplished in the fourth semester.

FOURTH SEMESTER

Code	Subject	Hrs / Week			Marks					Credits
		L	T	P	Internal		University		Total	
					Guide	Evaluation Committee	Thesis	Viva		
CAS 401 (P)	Thesis			22	200	200	100	100	600	12
	Total			**22**	**200**	**200**	**100**	**100**	**600**	**12**

Towards the middle of the semester there shall be a pre submission seminar to assess the quality and quantum of the work by the evaluation committee. This shall consist of a brief presentation of Third semester interim thesis report and the work done during the fourth semester. The comments of the examiners should be incorporated in the work and at least one technical paper is to be prepared for possible publication in journals / conferences. The final evaluation of the thesis shall be an external evaluation.

CAS 101 THEORY OF ELASTICITY

3 hours lecture per week

Introduction to the mathematical theory of elasticity**:** Elasticity, stress, strain, Hooke's law, two-dimensional idealisations, plane stress and plane strain problems, equations of equilibrium, strain-displacement relations, constitutive relations, compatibility conditions, displacement and traction boundary conditions.
Introduction to Cartesian Tensors: Transformation laws of cartesian tensors, special tensors and tensor operations, the Kronecker's delta, the permutation tensor, the *e*-d identity, symmetry and skew-symmetry, contraction, derivatives and the comma notation, Gauss' theorem, the base vectors and some special vector operations, eigenvalue problem of a symmetric second order tensor, equations of elasticity using index notation.

Two-dimensional problems in rectangular coordinates: Stress function, solution by polynomials, Saint Vénant's principle, bending of a cantilever, determination of displacements. Two-dimensional problems in polar coordinates: General equations, problems of axisymmetric stress distribution, pure bending of curved bars, effect of circular hole on stress distribution in plates, concentrated force at a point on a straight boundary.

Stress and strain problems in three dimensions: Principal stresses, principal strains, threedimensional problems. Energy Theorems and Variational Principles of Elasticity: Strain energy and complementary energy, Clapeyron's theorem, virtual work and potential energy principles, principle of complementary potential energy, Betti's reciprocal theorem, principle of linear superposition, uniqueness of elasticity solution.

Torsion of straight bars: Elliptic and equilateral triangular cross-section, membrane analogy, narrow rectangular cross-section, torsion of rectangular bars, torsion of rolled profile sections, hollow shafts and thin tubes.

References

1. Timoshenko, S.P. and Goodier, J.N., *Theory of Elasticity*, Mc Graw Hill, Singapore,1982.
2. Leipholz, H., *Theory of Elasticity*, Noordhoff International Publishing, Layden,1974.
3. Sokolnikoff, I.S., *Mathematical Theory of Elasticity*, Tata Mc Graw Hill, India,1974.
4. Xu, Z., *Applied Elasticity*, Wiley Eastern Ltd, India, 1992.
5. Srinath, L.S., *Advanced Mechanics of Solids*, Second Edition, Tata McGraw Hill,India,2003.
6. Ameen, M., *Computational Elasticity*

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 102 STRUCTURAL DYNAMICS

3 hours lecture per week

Over view:- Basic features of dynamic loading and response – models for dynamic analysis – lumped mass, generalized displacements and finite element models Formulation of equation of motion – Direct equilibration, principle of virtual displacement and Hamilton's principle.Degrees of freedom – Translational and rotational systems - mass moment of inertia Generalized single degree of freedom systems- rigid body assemblage determination of characteristic properties. Free vibration of single degree of freedom system:- Solution of equation of motion, undraped free vibration - Damped free vibration, critically damped, under damped and over damped systems, Negative damping.
Single degree of freedom system – Response:- Response to harmonic loading, Undamped system- damped system, Response to periodic loading -Fourier series expansion of the loading- response to Fourier series loading Exponential form of Fourier series loading and response- Complex frequency transfer functions Response to impulsive loads :- Suddenly applied load, sine wave impulse, rectangular impulse, triangular impulse, spike loading, approximate analysis Response to general dynamic loading:- Duhamel integral for undamped system – unit impulse response function – numerical evaluation, response of damped systemnumerical evaluation, Numerical analysis in the frequency domain, fast Fourier transform analysis.
Multi degree of freedom system:- Two degree of freedom system – equation of motion, characteristic equation, frequencies and mode shapes, coordinate coupling and choice of degree of freedom, orthogonality of modes, natural coordinates, superposition of natural modes , response of two degree of freedom system to initial excitation, beat phenomenon,response to harmonic excitation Multi- degree of freedom system – analysis of multi- degree of freedom system- mode superposition analysis. Distributed Parameter System: Partial differential equation of motion - Axial vibration of prismatic bars - Elementary CAS of flexural vibration of beams - Beam flexure including axial force effects.

Practical Vibration Analysis:- Determination of frequency by Rayliegh's method, beam flexure – selection of shape- improved Rayliegh's method. Framed structures – Shear building concept and models for dynamic analysis, discrete parameter system by Rayliegh's method, improvement of frequency, Stodola method for discrete parameter system, reduction of second and higher modes- Stodola method for continuous parameter system.

References

1. Clough,R.W. and Penzien, J., *Dynamics of structures*, McGraw Hill
2. Chopra, A.K., *Dynamics of structures – Theory and Application to Earthquake Engg.*,Prent. Hall.
3. IS 1893 – *Criteria for Earthquake Resistant Design of Structures*.
4. SP 22: *Explanatory Handbook on Codes for Earthquake Engineering*.
5. Meirovitch L., *Elements of Vibration Analysis*, Mc.Graw Hill.
6. Thomson W.T., *Theory of Vibration with Applications*, CBS Publ.
7. Craig, Jr. R.R., *Structural Dynamics*, John Wiley.
8. Hurty, W.C. and Rubinstein M.F., *Dynamics of Structures*, Prentice Hall.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 103 ADVANCED THEORY AND DESIGN OF CONCRETE STRUCTURES

3 hours lecture per week

Stress-strain characteristics of concrete under multi- axial stresses- confined concrete-Effect of cyclic loading on concrete and reinforcing steel. Ultimate Deformation and ductility of members with flexure- strength and deformation of members with tension -Control of deflections- immediate and long term deflections- Control of cracking – classical theory of cracking- International codal procedures on crack-width computation.

Strut and Tie Models- Development- Design methodology- selecting dimensions for struts-ACI Provisions- Applications- RCC beam – column joints- classification – shear strength-design of exterior and interior joints- wide beam joints.

Strength and ductility of concrete frames- analysis of shear walls- distribution of lateral loads in uncoupled shear walls- Equivalent stiffness method- Shear wall frameinteractions.

Behaviour and design of special RCC members- Design of concrete corbels- deep beams, ribbed, hollow block or voided slab- RCC walls.

References:

1. Arthur. H. Nilson, David Darwin and Charles W Dolan, *Design of Concrete Structures,* Tata McGraw Hill, 2004
2. Park,R and Paulay T, *Reinforced Concrete Structures*, John Wiley & Sons, New York
3. Macleod, I.A, *Shear Wall Frame Interaction*. A design aid with commentary Portland Cement Association.
4. Thomas T. C. Hsu, *Unified Theory of Reinforced Concrete*, CRC Press, London,1993.
5. IS 456 –2000, *Indian Standard for Plain and Reinforced Concrete- Code of Practice*, New Delhi
6. ACI – 318: 2002, *Building Code Requirements for Structural Concrete and Commentary*, ACI Michigan.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 104 FINITE ELEMENT METHOD

3 hours lecture per week

Boundary Value Problem - Approximate Solution - Variational and Weighted Residual Methods - Ritz and Galerkin Formulations - Concepts of Piecewise Approximation and Finite Elements - Displacement and Shape Functions - Weak Formulation - Minimum Potential Energy - Generation of Stiffness Matrix and Load Vector.

Basic concepts - Different methods in Finite Element Methods - Steps involved in FEM. Interpolation Polynomials - Linear elements Shape function - Element and Global matrices Two dimensional elements, triangular and rectangular elements - Local and Global Coordinate systems.

The Isoparametric Formulation:- Introduction – An isoparametric bar element – Plane bilinear element – Numerical Integration – Quadratic plane elements –– Triangular isoparametric elements

Finite element Solution of structural problems - Two dimensional elasticity problems – Plane Stress, Plain Strain and Axisymmetric Problems - Triangular and Quadrilateral Elements

Reference:

1. Cook, R.D., et al, *Concepts and Applications of Finite Element Analysis*, John Wiley.
2. Desai, C.S., *Elementary Finite Element Method*, Prentice Hall of India.
3. Chandrupatla, T.R., and Belegundu, A.D., *Introduction to Finite Elements in Engineering*, Prentice Hall of India.
4. Bathe, K.J., *Finite Element Procedures in Engineering Analysis*, Prentice Hall of India.
5. Gallaghar, R.H., *Finite Element Analysis: Fundamentals*, Prentice Hall Inc.
6. Rajasekaran, S., *Finite Element Analysis in Engineering Design*, Wheeler Pub.
7. Krishnamoorthy, C.S., *Finite Element Analysis – Theory and Programming*, Tata Mc Graw Hill.
8. Zienkiewicz, O.C., and Taylor, R.L., *The Finite Element Method*, Vol. I and II, Mc Graw Hill.
9. Bhatti, Asghar, *Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations*

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 105 (A) ADVANCED CONCRETE TECHNOLOGY

3 hours lecture per week

Ready Mixed Concrete - manufacture, transporting, placing, precautions, Methods of concreting- Pumping, under water concreting, shotcrete, High volume fly ash concrete concept, properties, typical mix
Self compacting concrete concept, materials, tests, properties, application and Typical mix.

Fibre reinforced concrete - Fibers types and properties, Behavior of FRC in compression, tension including pre-cracking stage and post-cracking stages, behavior in flexure and shear, Ferro cement - materials, techniques of manufacture, properties and application

Light weight concrete-materials properties and types. Typical light weight concrete mix High density concrete and high performance concrete-materials, properties and applications, typical mix.

Test on Hardened concrete-Effect of end condition of specimen, capping, H/D ratio, rate of loading, moisture condition. Compression, tension and flexure tests. Tests on composition of hardened concrete-cement content, original w/c ratio. NDT tests concepts-Rebound hammer, pulse velocity methods.

References:

1. Neville, A.M., "Concrete Technology", Longman Scientific & Technical, 1990.
2. Neville, A.M.., "Properties of Concrete", Longman Scientific & Technical, England, 1981.
3. Gambier, “Concrete Technology”, Tata McGraw Hill, New Delhi.
4. Orchard, D.F., "Concrete Technology", Vols. 1 & 2, 1963.
5. Shetty, M.S., "Concrete Technology", S.Chand & Co., New Delhi, 1998.
6. Rixon, M.R., "Chemical Admixtures for Concrete", John Wiley & Sons, 1977.
7. Krishnaraju, N. "Design of concrete mixes", Sehgal Educational Consultants & Publishers Pvt.Ltd., Faridabad, 1988.
8. IS: 10262, "Recommended Guidelines for concrete Mix Design", 1982

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 105 (B) MODELLING, SIMULATION AND COMPUTER APPLICATION

3 hours lecture per week

Numerical Solution of Nonlinear Equations Fixed point iteration – Newton-Raphson method – Broyden's method
Functional Approximations: - Choice of norm and model – linear least squares –nonlinear least squares – discrete Fourier transform – fast Fourier transform – FFT in two or more dimensions – inversion of Laplace transform – Chebyshev approximations.

Finite Difference Method: - Elliptic equations – Laplace equation – solution techniques – boundary conditions – the control volume approach.
Parabolic equations – the heat conduction equation – explicit method – simple implicit method – parabolic equation in two spatial dimensions.

Algebraic Eigenvalue Problem: - Eigenvalue problem for a real symmetric matrix – inverse iteration – QL algorithm for a symmetric tridiagonal matrix – reduction of a general matrix to Hessenberg form – Lanczos method – QR algorithm for a real Hessenberg matrix – errors.

Integral Equations: - Fredholm equations of the second kind – expansion methods – eigenvalue problem – Fredholm equations of the first kind – Volterra equations of the second kind – Volterra equations of the firs kind.

Simulation and Monte Carlo Methods:
Random number generation – congruential generators – statistical tests of pseudorandom numbers.

Random variate generation – inverse transform method – composition method – acceptance-rejection method.

Simulation of random vectors - inverse transform method – multivariate transform method – multinormal distribution.

Simulation of stochastic fields – one-dimensional and multidimensional fields.

References

1. Antia, H.M., Numerical Methods for Scientists and Engineers, Tata McGraw Hill.
2. Chapra, S.C., and Canale, R.P., Numerical Methods for Engineers, Tata McGraw Hill.
3. Rubinstein, R.Y., Simulation and the Monte Carlo Method, John Wiley.
4. Press, W.H., et al., Numerical Recipes in C, Cambridge University Press.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 105 (C) DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

3 hours lecture per week

INTRODUCTION

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

DESIGN OF COMPOSITE MEMBERS

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

DESIGN OF CONNECTIONS

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

COMPOSITE BOX GRIDER BRIDGERS

Introduction - Behaviour of box girder bridges - Design concepts.

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.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 105 (D) STRUCTURAL RELIABILITY

3 hours lecture per week

Concepts of structural safety
Basic Statistics:- Introduction, data reduction
Probability theory: Introduction, random events, random variables, functions of random variables, moments and expectation, common probability distributions.

Resistance distributions and parameters: - Introduction, Statistics of properties of concrete, steel and other building materials, statistics of dimensional variations, characterization of variables, allowable stresses based on specified reliability. Probabilistic analysis of loads: gravity loads, wind loads

Basic structural reliability:- Introduction, computation of structural reliability.
Level 2 Reliability methods: Introduction, basic variables and failure surface, first order second moment methods (FOSM)

Reliability based design: Introduction, determination of partial safety factors, development of reliability based design criteria, optimal safety factors

Monte Carlo study of structural safety: -General, Monte Carlo method, applications

Reliability of Structural system: Introduction, system reliability, modelling of structural systems, bounds of system reliability, reliability analysis of frames

References

1. R. Ranganathan., Reliability Analysis and Design of Structures, Tata McGraw Hill, 1990.
2. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design, Vol. I Basic Principles, John Wiley & Sons, 1975.
3. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design, Vol. II Decision, Risks and Reliability, John Wiley & Sons, 1984.
4. Jack R. Benjamin & C. Allin Cornell., Probability, Statistics and Decision for Engineers, McGraw-Hill.
5. H. O. Madsen, S. Krenk & N. C. Lind, Methods of Structural Safety, Prentice-Hall, 1986.
6. R. E. Melchers. Structural Reliability - Analysis and prediction, Ellis Horwood Ltd, 1987.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 106 (A) DESIGN OF BRIDGES

3 hours lecture per week

Introduction–classification and components of bridges– layout and planning– Structural forms of bridge decks – grillage analysis of slab decks, beam and slab decks, cellular decks.

Standard specifications for bridges – IRC loadings for road bridges – standards for railway bridges – design of RC slab, skew slab and box culverts. Design of T beam bridges – balanced cantilever bridges – rigid frame bridges – Arch bridges – bow string girder bridges.

Design of plate girder bridges – steel trussed bridges – Introduction to long span bridges: cable stayed bridges and suspension bridges –instability.

Forces on piers and abutments – Design of piers and abutments – types of wing walls – types of bearings – design of bearings.

Reference:

1. E.C. Hambly, Bridge deck behaviour, Chapman and Hall, London
2. E.J. O'Brien and D.L. Keogh, Bridge deck analysis, E& FN Spon, New York
3. D.Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi.
4. N.Krishna Raju, Design of bridges, Oxford & IBH publishing Co. Ltd., New Delhi.
5. Jaikrishna and O.P Jain, Plain and reinforced concrete-vol.II, Nem Chnand & Bros,Roorkee.
6. IRC: 5 -1970, Standard specifications and code of practice for road bridges, Sections I to V, Indian Roads Congress, New Delhi.
7. Indian railway standard code of practice for the design of steel or wrought iron bridge carrying rail, road or pedestrian traffic, Govt. of India, Ministry of Railways, 1962.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 106 (B) INDUSTRIAL STRUCTURES

3 hours lecture per week

PLANNING AND FUNCTIONAL REQIREMENTS
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.

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

POWER PLANT STRUCTURES
Bunkers and Silos - Chimneys and Cooling Towers - High Pressure boilers and piping design – Nuclear containment structures.

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, Transmission Line Structures, Tata McGraw Hill, 1992.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 106 (C) FORENSIC ENGINEERING AND REHABILITATION OF STRUCTURES

3 hours lecture per week

Failure of Structures: Review of the construction theory – performance problems – responsibility and accountability – case studies – learning from failures – causes of distress in structural members – design and material deficiencies – over loading

Diagnosis and Assessment of Distress: Visual inspection – non destructive tests – ultrasonic pulse velocity method – rebound hammer technique – ASTM classifications – pullout tests – Bremor test – Windsor probe test – crack detection techniques – case studies – single and multistorey buildings – Fibreoptic method for prediction of structural weakness

Environmental Problems and Natural Hazards: Effect of corrosive, chemical and marine environment – pollution and carbonation problems – durability of RCC structures – damage due to earthquakes and strengthening of buildings – provisions of BIS 1893 and 4326

Modern Techniques of Retrofitting: Structural first aid after a disaster – guniting, jacketing – use of chemicals in repair – application of polymers – ferrocement and fiber concretes as rehabilitation materials – strengthening by pre-stressing – case studies – bridges – water tanks – cooling towers – heritage buildings – high rise buildings.

References

1. Dovkaminetzky, Design and Construction Failures, Galgotia Publication, New Delhi,2001
2. Jacob Feld and Kenneth L Carper, Structural Failures, Wiley Europe.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 106 (D) MECHANICS OF COMPOSITE STRUCTURES

3 hours lecture per week

Introduction: - Composite beams- Elastic behaviour of composite beams- No interaction case- Full interaction case-Shear connectors-Characteristics of shear connectors-Ultimate load behaviour-Serviceability limits-Basic design considerations-Design of composite beams.

Composite floors: - Structural elements-Profiled sheet decking-Bending resistance-Serviceability criteria-Analysis for internal forces and moments.

Composite columns: - Materials-Structural steel-Concrete-Reinforced steel-Composite column design-Fire resistance-Combined compression and uniaxial bending

Continuous beams and slab Hogging moment regions of composite beams-Vertical shear and moment-Shear interaction-Global analysis of continuous beams-Design strategies

References

1 Johnson,R.P, Composite Structures of Steel and Concrete,Vol.1Beams,Slabs,Columns and Frames in Buildings, Oxford Blackwell Scientific Publications, London.

2 INSDAG teaching resource for structural steel design, Vol 2, INSDAG, Ispat Niketan, Calcutta.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 107(P) COMPUTATIONAL AND STRESS ANALYSIS LAB

2 hours Practical per week

At least 12 experiments should be conducted in the lab

A. COMPUTATIONAL LABORATORY

Introduction to Engineering Softwares - Introduction to O/S–storage and time optimisation - General purpose packages in Civil Engineering – Program Implementation-

Course Requirement

Students are expected to know at least one high-level language. They will be imparted instructions for using available computer systems – Each student will be assigned a term project in his area of interest and shall develop an application program.

B. STRESS ANALYSIS LABORATORY

Measurement of Strain: - Mechanical Strain Gauges- Electrical Strain gauges- Extensometers and Compressometers Measurement of Deflection:- Dial gauges - Linear Variable Differential Transducers Principles of operations of UTM, hydraulic loading systems, force measuring devices etc. Study of the behaviour of structural materials and structural members- Casting and testing of simple compression, tension and flexural members. Introduction to Non Destructive Testing of RCC members. New Reinforced Cement Composites:- Introduction to Steel fiber reinforced concrete – Ferrocement – Polymer concrete - Self Compacting Concrete – High Performance Concrete.

Course Requirement

Number of suitable experiments will be designed involving the use of above instruments, so that a student on successful completion of the course shall be in a position to use any of these instruments for experiments and testing work. A student will be required to conduct specified number of experiments and submit a report/record of such work. The grades will be awarded based on the performance in the laboratory work, report/record of experiments and a viva-voce examination conducted at the end of the course.

Sessional work assessment

Regularity – 5 marks
Class work, Lab Record, Mini Project Report (if any), viva – 30 marks
Test– 15 marks
Total: Internal continuous assessment: 50 marks

University evaluation

Examination will be for 100 marks of which 70 marks are allotted for writing the procedure/formulae/sample calculation details, preparation and conduct of experiment, tabulation, plotting of required graphs, results, inference etc., as per the requirement of the lab experiments, 20 marks for the viva-voce and 10 marks for the lab record.

Note: Duly certified lab record must be submitted at the time of examination

CAS 108 (P) SEMINAR

2 hours per week

The student is expected to present a seminar in one of the current topics in the field of specialization and related areas. The student shall prepare a Paper and present a Seminar on any current topic related to the branch of specialization under the guidance of a staff member. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject and submit seminar report at the end of the semester. The student shall submit typed copy of the paper to the Department. Grades will be awarded on the basis of contents of the paper and the presentation. A common format in (.pdf format) shall be given for reports of Seminar and Project. All reports of Seminar and Project submitted by students shall be in this given format.

Sessional work assessment
Presentation: 25
Report: 25
Total marks: 50

CAS 201 – ADVANCED PRESTRESSED CONCRETE DESIGN

3 hours lecture per week

Review on basic concept and principles of pre-stressed concrete systems, losses in prestress, Design and analysis of post and pre-tensioned members for flexure and shear;

Limit state design of statically determinate prestressed beams, limit state of collapse against flexure, shear, torsion. Limit state of serviceability – deflection and cracking, Anchorage zone stresses for post-tensioned members, Design of end block.

Statically indeterminate structures- Analysis and design-continuous beams and frames, choice of cable profile,- linear transformation and concordancy.

Composite construction with preast prestressed concrete beams and cast in site RC slab-analysis and design of composite section,-effect of creep and differential shrinkage, flexural and shear strength of composite sections. Partial prestressnig – limit state design of partially pre-stressed concrete beams, crack and crack-width computations. Analysis and design of pre-stressed concrete pipes, tanks and railway sleepers. Analysis of pre-stressed concrete spatial structures.

References

1. Lin.T.Y., *Design of Pre-stressed concrete structures*, Asia Publishing House
2. Sinha*., Prestressed Concrete*, Tata McGraw Hill Co.
3. Mallick and Rangaswamy, *Mechanics of Prestressed Cocrete Design,* Khanna Publishers.
4. Guyon Y.,*Introduction to prestressed concrete Vol I & II,* Asia Publishing House
5. Krishna Raju. ,*Prestressed Concrete*, Tata Mcgraw Hill Co.
6. Pandi & Gupta, *Prestressed Concrete*, CBS
7. F.K.Hong & R.H.Evans., *Reinforced and Prestressed Concrete*, Tata Mcgraw Hill Co.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 202 – THEORY OF PLATES AND SHELLS

3 hours lecture per week

Introduction:- Assumptions in the theory of thin plates – Pure bending of Plates –Relations between bending moments and curvature - Particular cases of pure bending of rectangular plates, Cylindrical bending - immovable simply supported edges – Synclastic bending and Anticlastic bending – Strain energy in pure bending of plates in Cartesian and polar co-ordinates – Limitations.

Laterally Loaded Circular Plates:- Differential equation of equilibrium – Uniformly loaded circular plates with simply supported and fixed boundary conditions – Annular plate with uniform moment and shear force along the boundaries.

Laterally Loaded Rectangular Plates: - Differential equation of plates – Boundary conditions – Navier solution for simply supported plates subjected to uniformly distributed load and point load – Levy's method of solution for plates having two opposite edges simply supported with various symmetrical boundary conditions along the other two edges loaded with u. d. l. – Simply supported plates with moments distributed along the edges - Approximate Methods.
Effect of transverse shear deformation - plates of variable thickness – Anisotropic plates thickplates- orthotropic plates and grids - Large Deflection theory .

Deformation of Shells without Bending:- Definitions and notation, shells in the form of a surface of revolution, displacements, unsymmetrical loading, spherical shell supported at isolated points, membrane theory of cylindrical shells, the use of stress function in calculating membrane forces of shells. General Theory of Cylindrical Shells:- A circular cylindrical shell loaded symmetrically with respect to its axis, symmetrical deformation, pressure vessels, cylindrical tanks, thermal stresses, inextensional deformation, general case of deformation, cylindrical shells with supported edges, approximate investigation of the bending of cylindrical shells, the use of a strain and stress function, stress analysis of cylindrical roof shells.

References

1. S.P Timoshenko and S.W Krieger, *Theory of Plates and Shells*, McGraw Hill
2. R. Szilard, *Theory and Analysis of Plates* – Classical Numerical Methods', Prentice Hall
3. N.K Bairagi, *Plate Analysis*, Khanna Publishers, New Delhi.
4. P.L Gould, *Analysis of Shells and Plates*, Springer-Verlag, New York, 1988.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 203 ADVANCED METAL STRUCTURES

3 hours lecture per week

Introduction - Plastic methods of analysis and design - plastic behavior under static and cyclic loading - static, kinematic and uniqueness theorems - shape factors – moment redistribution - Analysis of single and two bay portal frames - Plastic design with LRFD concepts - LRFD with elastic analysis - Current and future design philosophies.

Design of connections: Bolted connections - Failure modes of a joint - High strength bolts - HSFG bolts - Seat angle and web angle connections - moment resistant connections - semi rigid connections - Design of framed beam connection – continuous beam to beam connection.
Welded connections - Stiffened beam seat connection - Moment resistant joint – Tubular connections - Parameters of an in plane joint - Hotspots - Welds in tubular joints – Curved weld length at intersection of tubes - SHS and RHS tubes - design parameters – Advance types of welded connections.

Design of light gauge steel structures: Introduction – Types of cross sections – Materials– Local and post buckling of thin elements – Stiffened and multiple stiffened compression elements – Tension members – Beams and deflection of beams – Combined stresses and connections.

Design of industrial buildings: Design of members subjected to lateral loads and axial loads - Sway and non-sway frames, bracings and bents - Rigid frame joints - Knees for rectangular frames and pitched roofs - Knees with curved flanges - Valley joints – Rigid joints in multistorey buildings - Vierendeel girders. Design of Aluminum Structures: Introduction – Stress-strain relationship – Permissible stresses – Tension members – Compression members – Laced and battened columns – Beams – Local buckling of elements of compression – Riveted and bolted connections.

References

1. Gaylord ., *Design of steel structures*, McGraw Hill, New York.
2. Dayaratnam, P*., Design of steel structures*, Wheeler Pub.
3. Wie-Wen Yu.,*Cold-Formed Steel Structures*, McGraw Hill Book Company.
4. SP : 6(5) : *ISI Handbook for Structural Engineers - Cold Formed light gauge steel structures.*
5. SP : 6(6) : *Application of plastic theory in design of steel structures*.
6. IS : 801 : *Code of Practice for use of Cold-Formed light gauge steel structural members in general building construction*.
7. Lothers, *Advanced design in steel*, Prentice Hall, USA.
8. Chen, W.F., and Toma,., Advanced Analysis of Steel Frames.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 204 (A) – OFFSHORE STRUCTURES

3 hours lecture per week

WAVE THEORIES
Wave generation process, small and finite amplitude wave theories.

FORCES OF OFFSHORE STRUCTURES
Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

OFFSHORE SOIL AND STRUCTURE MODELING
Different types of offshore structures, foundation modeling, structural modeling.

ANALYSIS OF OFFSHORE STRUCTURES
Static method of analysis, foundation analysis and dynamics of offshore structures.

DESIGN OF OFFSHORE STRUCTURES

Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

References:

1. Chakrabarti, S.K. Hydrodynamics of Offshore Structures, Computational Mechanics Publications, 1987.
2. Thomas H. Dawson, Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983
3. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms,
American Petroleum Institute Publication, RP2A, Dalls, Tex.
4. Wiegel, R.L., Oceanographical Engineering, Prentice Hall Inc, Englewood Cliffs, N.J. 1964.
5. Brebia, C.A.Walker, S., Dynamic Analysis of Offshore Structures, New-nes Butterworths, U.K. 1979.
6. Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1, Krieger Publishing Company, Malabar,
Florida, 1991.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 204 (B) OPTIMISATION OF STRUCTURES

3 hours lecture per week

Problem formulation with examples. Single Variable Unconstrained Optimisation Techniques ¾ Optimality Criteria.
Bracketing methods: Unrestricted search, Exhaustive search.
Region Elimination methods: Interval Halving methods, Dichotomous search, Fibonacci method, Golden section method.
Interpolation methods: Quadratic Interpolation method, Cubic Interpolation method.
Gradient Based methods: Newton-Raphson method, Secant method, Bisection method.

Multi Variable Unconstrained Optimisation Techniques ¾ Optimality Criteria.
Unidirectional Search.
Direct Search methods: Random search, Grid search, Univariate method, Hooke's and Jeeves' pattern search method, Powell's conjugate direction method, Simplex method. Gradient based methods: Cauchy's (Steepest descent) method, Conjugate gradient (Fletcher-Reeves) method, Newton's method, Variable metric (DFP)method, BFGS method.

Constrained Optimisation Techniques
Classical methods: Direct substitution method, Constrained variation method, method of Lagrange multipliers, Kuhn-Tucker conditions.
Linear programming problem: Standard form, Simplex method.
Indirect methods: Elimination of constraints, Transformation techniques, and Penalty function method.
Direct methods: Zoutendijk's method of feasible direction, Rosen's gradient Projection method.

Specialized Optimisation techniques ¾ Dynamic programming, Geometric programming, Genetic Algorithms.

References:

1. Rao S. S., Engineering Optimisation – Theory and Practice, New Age International.
2. Deb, K., Optimisation for Engineering Design – Algorithms and examples, Prentice Hall.
3. Kirsch U., Optimum Structural Design, McGraw Hill.
4. Arora J S. Introduction to Optimum Design, McGraw Hill
5. Rajeev S and Krishnamoorthy C. S., Discrete Optimisation of Structures using Genetic Algorithms, Journal of Structural Engineering, Vol. 118, No. 5, 1992, 1223-1250.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 204 (C) PREFABRICATED STRUCTURES

3 hours lecture per week

INTRODUCTION

General Civil Engineering requirements, specific requirements for planning and I layout of prefabricates plant. IS Code specifications.

DESIGN PRINCIPLES

Modular co-ordination, standardization, Disuniting, of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

REINFORCED CONCRETE

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, single storey industrial buildings with trusses and shells, Crane-gantry systems.

FLOORS, STAIRS AND ROOFS

Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

WALLS

Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

DESIGN OF INDUSTRIAL BUILDINGS

Components of single-storey industrial sheds with crane gantry systems, Design of R.C. Roof Trusses, Roof Panels, Design of R.C.crane-gantry girders, corbels and columns, wind bracing design.

DESIGN OF SHELL ROOFS FOR INDUSTRIAL SHEDS

Cylindrical, Folded plate and hypar-prefabricated shells, Erection and jointing, joint design, hand book based design.

References

1. B.Lewicki, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/ New York, 1966.
2. Koncz.T., Manual of Precast Concrete Construction, Vol.I II and III, Bauverlag, GMBH, 1971.
3. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland Betor Verlag, 1978.
4. Lasslo Mokk, Prefabricated Concrete for Industrial and Public Sectors, Akademiai Kiado, Budapest, 1964.
5. Murashev.V., Sigalov.E., and Bailov.V., Design of Reinforced Concrete Structures, Mir Publishers, 1968.
6. CBRI, Building Materials and Components, 1990, India.
7. Gerostiza. C.Z., Hendrikson, C., Rehat D.R., Knowledge Based Process Planning for Construction and Manufacturing, Academic Press, Inc., 1989.
8. Warszawski, A., Industrialization and Robotics in Building - A managerial approach, Harper & Row, 1990.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 204 (D) DESIGN OF TALL BUILDINGS

3 hours lecture per week

DESIGN CRITERIA

Design philosophy, Loading, Sequential loading, materials - high performance Concrete - Fiber reinforced Concrete - Light weight Concrete - Design mixes.

LOADING AND MOVEMENT

Gravity Loading : Dead and live load, methods of live load reduction, Impact, gravity loading, construction loads.

Wind loading : Static and dynamic approach, Analytical and wind tunnel experimental method.

Earthquake loading : Equivalent lateral force, modal analysis, combinations of loading working stress design, Limit state design, plastic design.

BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS

Factors affecting growth, Height and Structural form. High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid mega system.

ANALYSIS AND DESIGN

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of building as total structural system considering overall integrity and major subsystem interaction, Anlysis for member forces, drift and twist, computerised general three dimentional analysis.

Structural elements : Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow. Design for diffenential movement, creep and shrinkage effects, temperature effects and fire resistance.

STABILITY OF TALL BUILDINGS

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation.

1. Taranath B.S., Structural Analysis and Design of Tall Building, McGraw Hill, 1988.
2. Dr. Y.P.Gupta, Editor. Proceedings National Seminar on High Rise Structures - Design and Construction practices for middle level cities Nov. 14 -16, 1995, New Age International Limited, Publishers, Madras -20.
3. Wilf gang Schuller, High Rise Building Structures, John Wiley and Sons, 1977.
4. Bryan stafford Smith, Alexcoull, Tall Building Structures , Analysis and Design, John Wiley and Sons, Inc., 1991.
5. T.Y.Lin, D.Stotes Burry, Structural Concepts and system for Architects and Engineers. John Wiley, 1988.
6. Lynn S.Beedle, Advances in Tall Buildings, CBS Publishers and Distributors, Delhi, 1986.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 205 (A) CONSTRUCTION PROJECT MANAGEMENT

3 hours lecture per week

Project Management - Trends in Modern Management - Strategic Planning and Project Programming - Effects of Project Risks on Organization - Organization of Project Participants - Traditional Designer-Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team - Interpersonal Behavior in Project Organizations - Perceptions of Owners and Contractors

Quality and Safety Concerns in Construction - Organizing for Quality and Safety – Work and Material Specifications - Total Quality Control - Quality Control by Statistical Methods - Statistical Quality Control with Sampling by Attributes - Statistical Quality Control with Sampling by Variables - Safety

Network techniques :– bar charts – Critical path method – Programme evaluation and review technique – Time estimates- uncertainties of time - time computations – monitoring of projects – updating - Crashing and time-cost tradeoff PERT and CPM-Software Development - Use of Management Software

Optimization techniques:- Resource allocation – Heuristic approach – Linear programming – Graphical and Simplex methods – Optimality Analysis – Material transportation and Work assignment problems

Materials management :- planning and budgeting – inventory control – management of surplus materials - equipment control

Process control:- work study- crew size – job layout- process operation.

The Cost Control Problem - The Project Budget - Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows - Schedule Control - Schedule and Budget Updates - Relating Cost and Schedule Information.

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs - Historical Cost Data – Cost Indices - Applications of Cost Indices to Estimating - Estimate Based on Engineer's List of Quantities - Allocation of Construction Costs Over Time - Computer Aided Cost Estimation - Estimation of Operating Costs.

References:

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Feigenbaum., L., "Construction Scheduling With Primavera Project Planner", Prentice Hall Inc., 1999.
3. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.
4. Choudhury, S, Project Management, Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. A.K Datta, Materials Management , Prentice Hall , India.
6. Arnold, J.R Tony, Introduction to Materials Mangement, Prentice Hall, India
7. Joy, P.K., Total Project Management – The Indian Context, Macmillan India Ltd., New Delhi, 1992.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 205 (B) STRUCTURAL HEALTH MONITORING

3 hours lecture per week

Review of Structural Modelling and Finite Element Models: Modelling for damage and collapse behaviour of structures, finite element modelling, theoretical prediction of structural failures.

Review of Signals, Systems and Data Acquisition Systems: Frequency and time domain representation of systems, Fourier/Laplace transforms, modelling from frequency response measurements, D/A and A/D converters, programming methods for data acquisition systems.

Sensors for Health Monitoring Systems: Acoustic emission sensors, ultrasonic sensors, piezoceramic sensors and actuators, fibre optic sensors and laser shearography techniques, imaging techniques.

Health Monitoring/Diagnostic Techniques: Vibration signature analysis, modal analysis, neural network-based classification techniques.

Integrated Health Monitoring Systems: Intelligent Health Monitoring Techniques, Neural network classification techniques, extraction of features from measurements, training and simulation techniques, connectionist algorithms for anomaly detection, multiple damage detection, and case studies.

Information Technology for Health Monitoring: Information gathering, signal analysis, information storage, archival, retrieval, security; wireless communication, telemetry, real time remote monitoring, network protocols, data analysis and interpretation.

Project Based Health Monitoring Techniques: Health monitoring techniques based on case studies, practical aspects of testing large bridges for structural assessment, optimal placement of sensors, structural integrity of aging multistorey buildings, condition monitoring of other types of structures.

References:

1. Philip, W., Industrial sensors and applications for condition monitoring, MEP, 1994.
2. Armer, G.S.T (Editor), Monitoring and assessment of structures, Spon, London, 2001.
3. Wu, Z.S. (Editor), Structured health monitoring and intelligent infrastructure, Volumes 1 and 2, Balkema, 2003.
4. Harris, C.M., Shock vibration handbook, McGraw-Hill, 2000.
5. Rao, J.S., Vibratory condition monitoring of machines, Narosa Publishing House, India, 2000.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 205 (C) GEOGRAPHIC INFORMATION SYSTEMS AND APPLICATIONS

3 hours lecture per week

Introduction:- Definitions of GIS – Components of GIS – Geographic data presentation: maps – mapping process – coordinate systems – transformations – map projection – geo referencing - data acquisition.

Geographic Data Representation, Storage, Quality and Standards:- Storage – Digital representation of data – Data structures and database management systems – Raster data representation – Vector data representation – Concepts and definitions of data quality – Components of data quality – Assessment of data quality – Managing data errors – Geographic data standards.

GIS Data Processing, Analysis and Modelling:- Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts and nearest neighbour analysis – Network analysis – Surface modelling – DTM.

GIS Applications:- (in one of the following areas) Applications of GIS in Environment monitoring – Natural hazard management – Natural resources management urban planning – utility management – Land information – Business development

References:

1. Lo, C.P. & Yeung A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice Hall of India, New Delhi, 2002.
2. Anji Reddy, M., Remote Sensing and Geographical Information Systems, B.S.Publications, Hyderabad, 2001.
3. Burrough, P.A., Principles of Geographical Information Systems, Oxford Publication, 1998.
4. Clarke, K., Getting Started with Geographic Information Systems, Prentice Hall, New Jersy, 2001.
5. DeMers, M.N., Fundamentals of Geographic Information Systems, John Wiley & Sons, New York, 2000.
6. Geo Information Systems – Applications of GIS and Related Spatial Information Technologies, ASTER Publication Co., Chestern (England), 1992
7. Jeffrey, S. & John E., Geographical Information System – An Introduction, Prentice-Hall, 1990
8. Marble, D.F., Galkhs HW & Pequest, Basic Readings in Geographic Information Systems, Sped System Ltd., New York, 1984.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 205 (D) ADVANCED DESIGN OF FOUNDATIONS

3 hours lecture per week

Soil - Structure Interaction

Introduction to Soil - Structure interaction problems - Contact pressure distribution – factors influencing Contact pressure distribution beneath rigid and flexible footings –concentrically and eccentrically loaded cases – contact pressure distribution beneath rafts - Modulus of sub grade reaction – Determination of modulus of sub grade reaction – Factors influencing modulus of subgrade reaction.

Pile Foundation: - Introduction – Estimation of pile capacity by static and dynamic formulae – Wave equation method of analysis of pile resistance – Load - Transfer method of estimating pile capacity – Settlement of single pile – Elastic methods. Laterally loaded piles – Modulus of sub grade reaction method – ultimate lateral resistance of piles. Pile Groups – Consideration regarding spacing – Efficiency of pile groups – Stresses on underlying soil strata – Approximate analysis of pile groups –Settlement of pile groups - Pile caps –Pile load tests – Negative skin friction.

Introduction to Machine Foundations:- Introduction - nature of dynamic loads – stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism - type of machine foundations - special considerations for design of machine foundations – Criteria for a satisfactory machine foundation – permissible amplitude of vibration for different type of machines - methods of analysis of machine foundations - methods based on linear elastic weightless springs - methods based on linear theory of elasticity (elastic half space theory) - degrees of freedom of a block foundation - definition of soil spring constants - nature of damping - geometric and internal damping - determination of soil constants - methods of determination of soil constants in laboratory and field based on IS code provisions.

Design of Machine Foundations:- Vertical, sliding, rocking and yawing vibrations of a block foundation - simultaneous rocking, sliding and vertical vibrations of a block foundation - foundation of reciprocating machines - design criteria - calculation of induced forces and moments - multi-cylinder engines - numerical example (IS code method)

Foundations subjected to impact loads - design criteria - analysis of vertical vibrations - computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations.

Reference:

1. Lambe and Whitman, Soil Mechanics, Wiley Eastern., 1976
2. Das B.M., Advanced Soil Mechanics, Mc. Graw-Hill, NY, 1985
3. Winterkorn H.F. and Fang H.Y. Ed., Foundation Engineering Hand Book, Van- Nostrand Reinhold, 1975
4. Bowles J.E., Foundation Analysis and Design (4th Ed.), Mc.Graw –Hill, NY, 1996
5. Poulose H.G. and Davis E.H., Pile foundation Analysis and Design, John-Wiley & Sons, NY, 1980.
6. Leonards G. Ed., Foundation Engineering, Mc.Graw-Hill,NY, 1962
7. Bowles J.E., Analytical and Computer Methods in Engineering Mc.Graw-Hill,NY
8. Shamsher Prakash, Soil Dynamics, McGraw Hill
9. Alexander Major, Dynamics in Soil Engineering
10. Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill
11. IS 2974 - Part I and II, Design Considerations for Machine Foundations
12. IS 5249: Method of Test for Determination of Dynamic Properties of Soils.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 205 (E) ADVANCED FINITE ELEMENT ANALYSIS

3 hours lecture per week

Plate Bending: Plate behaviour, Kirchhoff and Mindlin plate elements, boundary conditions. Shells: Shells of revolution, general shells, three- and four-noded shell elements, curved isoparametric elements.

Error, Error Estimation and Convergence: Sources of error, ill-conditioning, condition number, diagonal decay test, discretisation error, multimesh extrapolation, mesh revision methods, gradient recovery and smoothing, a-posteriori error estimate, adaptive meshing. Constraints, Penalty Forms, Locking and Constraint Counting: Explicit constraints, transformation equations, Lagrange multipliers, penalty functions, implicit penalty constraints and locking, constraint counting, modelling incompressible solids.

Finite Elements in Structural Dynamics and Vibrations: Dynamic equations, mass and damping matrices, consistent and lumped mass, natural frequencies and modes, reduction of the number of degrees of freedom, modal analysis, Ritz vectors, harmonic response, direct integration methods, explicit and implicit methods, stability and accuracy, analysis by response spectra.

Modelling Considerations and Software Use: Physical behaviour versus element behaviour, element shapes and interconnections, test CASs and pilot studies, material properties, loads and reactions, connections, boundary conditions, substructures, common mistakes, checking the model, critique of computed results.

Introduction to Nonlinear Problems: Nonlinear problems and some solution methods, geometric and material nonlinearity, problems of gaps and contacts, geometric nonlinearity, modelling considerations.
Stress Stiffening and Buckling: Stress stiffness matrices for beam, bar and plate elements, a general formulation for [ks], bifurcation buckling, remarks on [ks], its use, and on buckling and buckling analysis.

Reference:

1. Cook, R.D., et al, Concepts and Applications of Finite Element Analysis, Fourth Edition, John Wiley & Sons Inc., Singapore, 2003.
2. Desai, C.S., and Kundu, T., Introductory Finite Element Method, CRC Press, London, 2001
3. Bathe, K.J., Finite Element Procedures, Prentice Hall of India.
4. Zienkiewicz, O.C., and Taylor, R.L., The Finite Element Method, Vols. I and II, Mc Graw Hill.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 206 (A) STABILITY OF STRUCTURES

3 hours lecture per week

FUNDAMENTAL CONCEPTS:
Concept of stability, instability and bifurcation, different forms of structural instability, analytical approaches of stability analysis.

DISCRETE SYSTEMS:
Law of minimum potential energy and its implication, stability of single and two-degrees of freedom systems, large deflection analysis, effect of small imperfections.

COLUMNS:
Governing differential equation, cases of standard boundary conditions, effective length concept, elastically restrained column, column with geometric imperfections, eccentrically loaded column, large deflection analysis.

BEAM-COLUMNS & FRAMES:
Standard cases of beam columns, continuous columns and beam columns, single-storey frames, frames with sway and no-sway, buckling analysis using stiffness method, Haarman's method.

THIN RECTANGULAR PLATES:
Governing differential equation and boundary conditions, plate with all edges simply supported, plates with other boundary conditions, buckling under in-plane shear, post buckling analysis.

LATERAL-TORSIONAL BUCKLING:
Torsional buckling, torsional-flexural buckling, lateral buckling of beams with symmetric I-section.

References

1.Timoshenko.S.P & Gere.J.M , Theory of elastic stability Mc. Graw Hill Book Co.
2.Brush & Almorth, Buckling of bars, plates and shells. Mc. Graw Hill Book Co.
3.Aswin Kumar, Stability theory of structures Mc. Graw Hill Book Co.
4.Chajes,A., principles of structural stability theory, Prentice Hall Inc., Englewood Cliffs, New Jersy.
5. Iyengar, N.G.R., structural Stability of Columns and Plates, East West Press.
6. Kumar,a., Stability of structures, Allied Publishers Limited.
Publishers, London. 2001
7. Chen, W.F. & Lui, E.M.: Structural Stability, Elsevier (1987).

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 206 (B) EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES

3 hours lecture per week

Introduction to engineering seismology – Seismic waves primary and secondary waves – Raleigh wave - Love wave – Magnitude of earthquake – Intensity

Concept of Seismic design : Approach to earthquake resistant design – General principles of a seismic design – Review of IS 1893:2002 – Building equivalent static analysis – Vertical distribution of seismic forces and horizontal shears – Dynamic analysis – Design spectrums – Seismic weights – Modal combination – Load combinations and permissible stresses – Guide lines for earthquake resistant design – Ductile detailing for seismic design

Special structures: Design of water tanks – Elevated tower supported tanks- Hydrodynamic pressure in tanks – examples

Design of towers – Stack like structures – Chimneys – Design principles of retaining walls – Concept of design of bridges – Design of bearings

References

1. IS: 1893-2002, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part I, General Provisions, BIS, New Delhi, p.39
2. IS:1893-1984, Indian Standard Criteria for Earthquake Resistant Design of Structures, BIS, New Delhi, p.77
3. IS: 4326-1993, Indian Standard Code of practice for Earthquake Resistant Design and Construction of Buildings, BIS, New Delhi, 1993
4. SP:22-1982, Explanatory Hand Book on Codes of Earthquake Engineering, BIS, New Delhi, 1982.
5. IS:13920-1993, Indian Standard Ductile Detailing of RCC Structures subjected to seismic forces – Code of practice, 1993, p.16
6. Lecture notes prepared by Department of Earthquake Engineering, IIT Roorkee, 2002
7. Short term course notes on Earthquake Resistant Design , by Sudhir K Jain & CVR Murthy, I.I.T Kanpur

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 206 (C) WIND AND CYCLONE EFFECTS ON STRUCTURES

3 hours lecture per week

INTRODUCTION

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

WIND TUNNEL STUDIES

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

WIND EFFECT

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

DESIGN PRINCIPLES

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

CYCLONE AND DESIGN

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

References

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

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 206 (D) THEORY OF PLASTICITY

3 hours lecture per week

Preliminaries: Basic equations of theory of elasticity:- Index notation, equations of equilibrium, constitutive relations for isotropic bodies, strain-displacement relations, compatibility, displacement and traction boundary conditions, admissibility of displacement and stress fields, plane stress and plane strain problems.
Framework of Plastic Constitutive Relations:- Plastic behaviour in simple tension, generalisation of results in simple tension, yield surfaces, uniqueness and stability postulates, convexity of yield surface and normality rule, limit surfaces.

Initial Yield Surfaces for Polycrystalline Metals:- Summary of general form of plastic constitutive equations, hydrostatic stress states and plastic volume change in metals, shear stress on a plane, the von Mises initial yield condition, the Tresca initial yield condition, consequences of isotropy.
Plastic Behaviour under Plane Stress Conditions:- Initial and subsequent yield surfaces in tension-torsion, the isotropic hardening model, the kinematic hardening model, yield surfaces made of two or more yield functions, piecewise linear yield surfaces, elastic perfectly plastic materials.

Plastic Behaviour of Bar Structures:- Behaviour of a three bar truss, behaviour of a beam in pure bending, simply supported beam subjected to a central point load, fixed beams of an elastic perfectly plastic material, combined bending and axial force.
The Theorems of Limit Analysis: Introduction, theorems of limit analysis, alternative statement of the limit theorems, the specific dissipation function.

Limit Analysis in Plane Stress and Plane Strain:- Discontinuities in stress and velocity fields, the Tresca yield condition in plane stress and plane strain, symmetrical internal and external notches in a rectangular bar, the punch problem in plane strain, remarks on friction.

Limit Analysis as a Programming Problem:- Restatement of limit theorems, application to trusses and beams, use of finite elements in programming problem, incremental methods of determining limit load.

References

1 Martin, J.B., Plasticity: Fundamentals and General Results, MIT Press, London.
2 Kachanov, L.M., Fundamentals of the Theory of Plasticity, Mir Publishers, Moscow.
3 Chakrabarty, J, Theory of Plasticity, McGraw Hill, New York.
4 Hill, R., Mathematical Theory of Plasticity, Oxford University Press.
5 Chen, W.F., and Han, D.J., Plasticity for Structural Engineers, Springer Verlag.

Question Pattern:

There would be 7 questions out of which 5 should be answered. Each question would carry 20 marks each. Each question shall carry a maximum of four sub sections which can have uneven distribution of marks. The questions would touch upon all the sections of the syllabus as far as possible and would preferably be analytic in nature.

CAS 207 (P) - STRUCTURAL ENGINEERING DESIGN STUDIO

2 hours Practical per week

(Using software like SAP, ETABS, ANSYS etc.)

Concrete Structures: -

Analysis, design and detailing of solid slabs in a typical floor for a residential building- Analysis, design and detailing of beams in a typical intermediate floor of a multi-storey building- Analysis, design and detailing of circular ring beam supporting an overhead water tank- Analysis, design and detailing of a ribbed slab floor system- Generation of interaction curves for RC rectangular columns- Design of slender columns subject to biaxial bending- Analysis, design and detailing of shear walls- considering shear wallframe interaction in a tall RC structure subject to wind loading- Application of strut-andtie method to design and detail various RC elements and junctions.

Metal Structures: -Design of Steel Industrial Building - Design of Steel Multi-storey uilding - Design of Material Handling system - Design of steel Bridge - Design of pre-engineered buildings Design of storage structures - Design of towers

References

1. Arthur. H. Nilson, David Darwin and Charles W Dolan, *Design of Concrete Structures,* Tata McGraw Hill, 2004
2. Park,R and Paulay T, *Reinforced Concrete Structures*, John Wiley & Sons, New York
3. Macleod, I.A, *Shear Wall Frame Interaction*. A design aid with commentary Portland Cement Association.
4. IS 456 :2000, *Indian Standard for Plain and Reinforced Concrete- Code of Practice*, BIS, New Delhi
5. IS 13920 : 1993, *Indian Standard for Ductile Detailing of Reinforced Concrete Structures subjected toSeismic Forces - Code of Practice*, BIS, New Delhi
6. Gaylord ., *Design of steel structures*, McGraw Hill, New York.
7. Dayaratnam, P.*, Design of steel structures*, Wheeler Pub.

Sessional work assessment

Regularity – 5 marks
Class work, Lab Record, Mini Project Report (if any), viva – 30 marks
Test– 15 marks
Total: Internal continuous assessment: 50 marks

University evaluation

Examination will be for 100 marks of which 70 marks are allotted for writing the procedure/formulae/sample calculation details, preparation and conduct of experiment, tabulation, plotting of required graphs, results, inference etc., as per the requirement of the lab experiments, 20 marks for the viva-voce and 10 marks for the lab record.

Note: Duly certified lab record must be submitted at the time of examination

CAS 208 (P) TERM PAPER

The student is expected to present a report on the literature survey conducted as a prior requirement for the project to be taken up in the third and fourth semesters. Head of department can combine TP hours of many weeks and allot a maximum of 4 weeks exclusively for it. Students should execute the project work using the facilities of the institute. However, external projects can be taken up, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of department before taking up external project work. Project evaluation committee should study the feasibility of each project work before giving consent. An overview on the project work should be introduced before the closure of first semester. A paper should be prepared based on the project results and is to published in refereed Conferences/Journals.

Sessional work assessment
Presentation: 25
Report: 25
Total marks: 50

CAS 301 (P) THESIS – PRELIMINARY

This shall comprise of two seminars and submission of an interim thesis report. This report shall be evaluated by the evaluation committee. The fourth semester Thesis-Final shall be an extension of this work in the same area. The first seminar would highlight the topic, objectives, methodology and expected results. The first seminar shall be conducted in the first half of this semester. The second seminar is presentation of the interim thesis report of the work completed and scope of the work which is to be accomplished in the fourth semester.

Weightages for the 8 credits allotted for the Thesis-Preliminary

Evaluation of the Thesis-Preliminary work: by the guide - 50% (200 Marks)

Evaluation of the Thesis–Preliminary work: by the Evaluation Committee-50%(200 Marks)

CAS 401 (P) THESIS

Towards the end of the semester there shall be a pre submission seminar to assess the quality and quantum of the work by the evaluation committee. This shall consist of a brief presentation of Third semester interim thesis report and the work done during the fourth semester. At least one technical paper is to be prepared for possible publication in journals / conferences. The final evaluation of the thesis shall be an external evaluation. The 12 credits allotted for the Thesis-Final may be proportionally distributed between external and internal evaluation as follows.

Weightages for the 12 credits allotted for the Thesis
Internal Evaluation of the Thesis work: by the guide - (200 Marks)
Internal Evaluation of the Thesis work: by the Evaluation Committee - (200 Marks)

Final Evaluation of the Thesis work by the Internal and External Examiners:-
(Evaluation of Thesis + Viva Voce) - (100+100 Marks)

Annexure II
Details of Faculty in Department of Civil Engineering

SI No.	Designation	Name	Qualification	Remarks	Experience in years		
					Teaching	Research	Industry
1	**Professor**	Dr. V. I. Beena	Ph.D.	Structural Engineering	20	3	Nil
2	**Associate Professor**	Ms. Daya Krishnankutty	M Tech	Transportation Engineering	22	Nil	Nil
3	**Asst. Professor**	Dr. Rajesh K.N.	Ph.D	Structural Engineering	10	3	1
4		Dr. Rajeevan B.	Ph. D	Structural Engineering	10	3	2
5		Mr. Saji K.P	M Tech	Structural Engineering	8	Nil	6
6		Mr. Ajith M S	M Tech	Structural Engineering	3	Nil	2.5
7		Mr. Narayanan N. I	M Tech	Structural Engineering	Nil	Nil	10
8	**Adhoc Asst. Professor**	Ms. Nadiya Abdul Rahman	B. Tech	Civil Engineering	1	Nil	Nil
9		Ms. Nazeera M.	B. Tech	Civil Engineering	Nil	Nil	Nil
10		Ms. Shyna Valsan P.	B. Tech	Civil Engineering	1	Nil	2
11		Ms. Mumtaz V. N.	B. Tech	Civil Engineering	Nil	Nil	Nil
12		Ms. Subitha Chandran	B. Tech	Civil Engineering	Nil	Nil	Nil