COMPUTER AIDED STRUCTURAL ENGINEERING

SCHEME

SEMESTER I

Sl. No.	Course Number	Subject	Hrs/Week			Evaluation Scheme (Marks)					Credits $L+\left(\frac{T+P}{2}\right)$
						Sessional Exam (internal)			ESE	Total	
			L	T	P	TA	CT	Sub. Total			
1	MCE101	Analytical Methods in Engineering	4	0	0	25	25	50	100	150	4
2	MCE 102	Advanced Structural Analysis	3	1	0	25	25	50	100	150	3.5
3	MCE 103	Structural Dynamics	3	1	0	25	25	50	100	150	3.5
4	MCE 104	Theory of Elasticity	3	1	0	25	25	50	100	150	3.5
5	MCE 105	Object Oriented Programming	4	0	0	25	25	50	100	150	4
6	MCE 106	Elective-I	3	1	0	25	25	50	100	150	3.5
7	MCE107	Seminar-I	-	0	2	50	-	50	0	50	1
8	MCE108	Computer Programming Lab	-	0	4	25	25	50	100	150	2
Total			20	4	6			400	700	1100	25

TA – Teachers' Assessment (Quizzes, attendance, group discussion, tutorials, seminar, field visit etc)
CT – Class Test; Minimum two to be conducted by the institute
ESE – End Semester Exam will have to be conducted by the institute through concerned affiliating University.
L - Lecture, T-Tutorial, P-Practical

MCE 106. Elective I

MCE 106.1 Advanced Structural Design
MCE 106.2 Structural Reliability
MCE 106.3 Fracture Mechanics

SYLLABUS

MCE 101 ANALYTICAL METHODS IN ENGINEERING

(4hr/week)

Module I

Differential equations: Linear differential equations-homogeneous equations-boundary value problems-Cauchy-Euler equations-factoring the operator-nonhomogeneous equations-variation of parameters

Module II

Partial differential equations: Ordinary differential equations in more than two variables – first order P.D.E-integral surface passing through a given curve-surfaces orthogonal to given system-compatible systems of first order P.D.E-charpits method-solution satisfying the given conditions-P.D.E second order in physics-linear P .D.E with constant coefficients

Module III

Boundary value problems: elementary solutions of Laplace equations,wave equations, series solution of these equations in two dimensions-related problems in engineering.

Module IV

Numerical solutions of P.D.E: classification of second order equation- finite difference approximations to partial derivatives- solution of Laplace equation by finite difference method-solution of one dimensional wave equations.

References: -

1. Michael D Greenberg, Advanced Engineering Mathematics, Pearson education.
2. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, International Editions.
3. B.S Grewal, Numerical Methods in Engineering and Science, Khanna Publications.
4. P Kandasamy, Numerical Methods, S Chand and company.
5. S.Arumugam,A. Thangapandi Issac Numerical methods, Scitech.
6. George.F. Simmons, Differential Equations with applications and historical notes ,TMH Edition

MCE 102 ADVANCED STRUCTURAL ANALYSIS

(4hr/week)

Module I

Work and energy principles:- Strain and complementary energies-Strain energy expressions for tension, bending, torsion-principle of superposition –Maxwell, Betti, Castigliano theorems-equations of compatibility-principles of real work- virtual work.

Module II

Matrix methods: Classification of structures-discrete structures-elements-nodes-degrees of freedom-static& kinematic indeterminacy Stiffness method-coordinate systems-element stiffness matrix

Module III

Element approach- stiffness method - analysis of pinjointed frames (temperature effect, lack of fit), continuous beams(settlement of supports), rigid jointedframes and grids.

Module IV

Direct stiffness approach - structure stiffness matrix-assembly-equivalent joint load –incorporation of boundary conditions –solutions-Gauss elemination-matrix inversion-analysis of pinjointed frames, continuous beams.

Module V

Flexibility method:-Element Flexibility matrix-truss element-beam element-force transformation matrix – equilibrium-compatibility-analysis of beams & frames (rigid and pinjointed), grids.

References: -

1. Weaver &Gere, Matrix Analysis of Structures, East West Press.
2. MosheFRubinstein– Matrix Computer Analysis of Structures- Prentice Hall, 1969.
3. Meek J.L., Matrix Structural Analysis, McGraw Hill, 1971.
4. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Co.1996.
5. Smith J.C. Structural Analysis, Macmillian Pub.Co.1985.
6. Rajesekharan & Sankarasubramanian,G., Computational Structural Mechanics, Prentice Hall of India, 2001.
7. Mukhopadhyay M., Matrix Finite Element Computer and Structural Analysis, Oxford & IBH, 1984.
8. Wang C.K.& Solomon C.G., Introductory Structural Analysis, McGraw Hill.1968.
9. Pezemieniecki, J.S,Theory of Matrix Structural Analysis, McGraw Hill Co.,1984
10. Seeli F.B.&Smith J.P., Advanced Mechanics of Materials, John Wiley &Sons, 1993.
11. Norris & Wilbur, Elementary Structural Analysis, McGraw Hill.

MCE 103 STRUCTURAL DYNAMICS

(4 hrs/week)

Module I

Introduction: Objectives − types of dynamic problems − degree of freedom − D' Alemberts Principle − principle of virtual displacement − Hamilton's principle

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Module II

Single degree of freedom system Undamped and damped free vibrations −critical damping − over damping − under damping − logarithmic decrement

Module III

Single degree of freedom system Undamped and damped forced Vibration − response to harmonic loading − evaluation of damping − vibration isolation − transmissibility − response to periodic forces.

Module IV

Multidegree freedom systems and Continuous systems: Natural modes − orthogonality conditions − modal Analysis − free and forced vibration − Free longitudinal vibration of bars − flexural vibration of beams with different end conditions − forced vibration.

Module V

Approximate methods: Rayleigh's method − Dunkerley's method − Stodola's method − Rayleigh -Ritz method − Matrix method.

References: -

1. Clough & Penzien, Dynamics of Structures.
2. Meirovitch.L, Elements of Vibration Analysis.
3. W.T. Thomson , Vibration Theory and Applications
4. M.Mukhopadhyay , Vibrations, Dynamics & Structural systems
5. Paz Mario, Structural Dynamics-"Theory and Computation".
6. Denhartog, Mechanical vibrations.
7. Timoshenko , Vibration Problems in Engineering.
8. Anil K Chopra, Dynamics of structures, Pearson Education.

MCE 104 THEORY OF ELASTICITY

(4 hrs/week)

Module I

Elasticity

Basic concepts- Body force-Surface traction-Stresses and strains-Three dimensional stresses and stains-analysis-transformation equations of 3D stresses & strains-principal stresses&strains-States of stresses&strain-Equilibrium equations-generalised Hooke's Law-Compatibility Conditions-Boundary conditions.

Module II

Two dimensional stress-strain problems- Plane stress and plain strain- Analysis-transformation equations-stress-strain relations-equilibrium equations in Cartesian and polar co ordinates Airy's stress function- Biharmonic Equilibrium-St Venant's principle-2D problems in Cartesian coordinate-cantilever with concentrated load at free end-Simply supported With UDL-Cantilever with moment at free end.

Module III

Analysis of stresses and strains in axisymmetric cases- General equations in polar co ordinates-Stress distribution symmetric about an axis-Pure bending of curved bar subjected to end moment-Cylinder subjected to external and internal pressures-Effect of circular holes on stress distribution in plates- Effect of concentrated load in straight boundaries- Bending of circular plate- Rotating disc as a 2D problem.

Module IV

Torsion of Circular and Non-Circular sections- Torsion of prismatic bar- General solution-Warping function approaches - St. Venant's theory- Membrane analogy- Sand heap analogy- Torsion of Circular & Non Circular sections - Torsion of multi celled thin wall open and closed sections.

Module V

Plasticity

Introduction to Plasticity - General concepts – Stress strain Curves-Ideal plastic body-Plastic flow conditions- Theories of failure-Plastic work-Plastic potential-Yield criteria-Simple applications- Elasto-Plastic analysis for bending and torsion of bars –Residual stresses.

References: -

1. Timoshenko S P and Goodier J. N, Theory of elasticity, Tata Mcgraw Hill International Student Edition.
2. Johnson W and Mellor P. B, Plasticity for mechanical engineers, Van Nostrand Company Ltd.
3. Sadhu Singh, Theory of elasticity, Khanna Publishers, Delhi.
4. Sadhu Singh, Theory of Plasticity, Khanna Publishers, Delhi.

5. Srinath L. S, Advanced mechanics of solids, Tata McGraw- Hill Publishing Company Ltd., New Delhi.
6. Arthur P Boresi & Omar M SideBottom, Advanced Mechanics of Materials, John Wiley & Sons..
7. Sokolnikoff, Mathematical Theory of Elasticity.

MCE 105 OBJECT ORIENTED PROGRAMMING

(4 Hrs/week)

Module I

Introduction-OOP concepts-Comparision with Procedural languages-Data types: integer, character, float, double, long double-Declarations-Expressions-Statements-Operators-arithmetic, logical and relational operators.

Module II

I/O methods-Input output statements: cin, cout, comments-Library functions-structures-pointers-arrays-Functions: passing arguments to functions, returning values from functions, overloaded functions, inline functions-friend functions.

Module III

Objects and Classes-A simple class- C++ objects as physical objects- C++ objects and data types-Constructors: overloaded constructors, copy constructors-Destructors-Operator overloading.

Module IV

Inheritance and Polymorphism - Inheritance: Base and Derived class--public and private inheritance-types of inheritance-Pointers to objects-Pointers to derived class-Polymorphism- Virtual functions-Pure virtual functions.

Module V

Visual C++ - VC++ IDE-MFC Programming-The document view architecture-SDI, Multiple documents Interface.

Programming should be from structural analysis and design

Reference: -

1. Bjarne Stroustrup , The C++ programming, Pearson Education
2. Ashok N Kamthane, Object Oriented Programming with ANSI & Turbo C++, Pearson Education
3. Richard Leineekar, Wiley Dreamtech , Visual C++ Programming Bible

4. Steve Holzner , Professional VC++ programming.
5. Hithesh Sanghavi, Vikas , Programming with VC++
6. Gary J Bronson, Brooks/ Cole, Thomson Lerning, A first book of VC++

MCE 106.1 ADVANCED STRUCTURAL DESIGN (ELECTIVE I)

(4hr/week)

Module I

Concrete structures

Yield line method and strip method
Design of grid floor
Design of continuous beams and portal frames

Module II

Design of storage structures like silos, bunkers and chimney
Design of prestressed water tanks and pipes

Module III

Steel design

Plastic analysis: statement of Plastic moment theorems - shake down theorem- with examples- general methods of plastic design – trial and error method-method of combining mechanisms-method of plastic moment distribution- factors affecting the fully plastic moment. -Plastic analysis and design of continuous beams, gable frames two bay and two storeyed frames.

Module IV

Design of steel structures as per codal provisions-continuous beams, industrial building frames (Analysis is not expected). Design of light gauge sections.

References: -

1. Pippard A J S, The Analysis of Engineering Structures, Edward Arnold PublishersLtd.
2. Krishna Raju N., Advanced Reinforced Concrete Design, CBS Publishers and distributers, New Delhi.
3. Gaylord C N & Gaylord E H, Design of steel structures, McGraw Hill BookCompany, London.
4. Lynn S Beedle, Plastic analysis of steel frames.
5. Ram Chandra, Design of Steel Structures II, Standard Book House, Delhi.

6. B.C Punmia,Ashok K Jain,Arun K Jain ,Reinforced Concrete Vol:II
7. P C Varghese, Limit state Design of concrete structures.
8. Dayaratnam, Design of steel structures.
9. Rajagopalan, Design of Storage structures
10. Baker, Steel skeleton.
11. Relevant IS Codes.

MCE 106.2 STRUCTURAL RELIABILITY (ELECTIVE I)

(4hr/week)

ModuleI

Concepts of structural safety.
Basic statistics:-Introduction-data reduction-histograms-sample correlation.

ModuleII

Probability theory, resistance distribution and parameters:- Introduction- statistics of properties of concrete and steel, statistics of strength of bricks and mortar, dimensional variations-characterisation of variables of compressive strength of concrete in structures and yield strength of concrete in structures and yield strength of steel – allowable stresses based on specified reliability.

ModuleIII

Probabilistic analysis of loads: - Gravity load-introduction-load as a stochastic process. Wind load-introduction-wind speed-return period-estimation of lifetime wind speed-probability model of wind load.

ModuleIV

Basic structural reliability: - Introduction-computation of structural reliability. Monte cario study of structural safety and applications.

Module V

Level-2 Reliability method: - Introduction-basic variables and failure surface-first order second moment methods like Hasofer and Linds method-nonnormal distributions-determination of B for present design-correlated variables.

References:-

1. Nobrert Llyd Enrick, Quality control and reliability, Industrial press New York.
2. A K Govil, Reliability engineering, Tata Mc Graw Hill, New Delhi.
3. Alexander M Mood, Introduction to tht theory of statistics, Mc Graw Hill, Kogakusha Ltd.
4. Ranganathan, Reliability of structures.

MCE 107 SEMINAR I

(2hr/week)

Each student is required to present a technical paper on a subject approved by the department. The paper should be on a recent advancement/trend in the field of structural engineering. He/she shall submit a report of the paper presented to the department.

MCE 108 COMPUTER PROGRAMMING LAB

(4hr/week)

Development of computer codes in C++ and VC++ for analysis and design of structural elements and its implementation. This may be carried out using the concepts given in the theory courses.