FIRST SEMESTER

Course Description

Title: Advanced Structural Analysis **Code: CE501**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Structural Analysis

Objective:
The objective of this course is to assimilate the techniques to solve complex real time problems in the field of structural analysis through contemporary methods.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the factors which affect the structural stability and equilibrium of structure.
CO2	**Identify** suitable advanced method of finding member forces and equilibrium.
CO3	**Develop** the matrix methods of analysis.
CO4	**Describe** the structural behavior based on the results of analysis.
CO5	**Determine** the bending moment and shear force of structures using stiffness and flexibility matrices.
CO6	**Apply** the advanced theories for complex problems.

Course Content:
Unit 1: Basic concepts, Degree of static and kinematic indeterminacy

Unit 2: Matrix algebra, Solution of simultaneous equations by Gaussian Elimination, Flexibility and Stiffness Matrices.

Unit 3: System Approach: Development of stiffness matrix, Applications of stiffness method to continuous beams, trusses and frames, Effect of temperature and pre-strain.

Unit 4: Element Approach: Element stiffness, 2D truss element and beam element, Transformation matrix, Assembly of global stiffness matrix, Storage requirement of stiffness matrix i.e. full storage, banded storage and skyline storage,

Unit 5: Effect of node and element numbering, Boundary conditions, Application of stiffness method to beams, trusses and frames.

Unit 6: Computer Applications, Material and Geometrical Non-Linearity, Application of Virtual Work and Energy Principles.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizzes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Advanced Structural Analysis (will be added from time to time): Digital copy will be available on the JUET server.

Text Books

1. Advanced Structural Analysis by Devdas Menon

2. Advanced Structural Analysis by Hamidreza Hashamdar, Zainah Binti Ibrahim, Mohammed Jameel

References:

1. Basic structural analysis by C.S Reddy, Prentice Hall of India Pvt. Ltd.
2. Matrix Method of Analysis of Framed structure by Weaver and Gere, CBS Publication
3. Bhavikatti, S.S, Structural Analysis, Vol.1,& 2, Vikas Publishing House Pvt.Ltd.,NewDelhi 4,2014.
4. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing House Pvt.Ltd,NewDelhi-4,2014.
5. Vazrani.V.N and Ratwani, M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.
6. Pandit G.S.andGupta S.P., Structural Analysis–AMatrix Approach, Tata McGraw Hill Publishing Company Ltd.,2006

Course Description

Title: Structural Dynamics **Code: CE502**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisites: Basic Structural Analysis

Objective:

The objective of this course is to introduce the fundamentals Structural Dynamics and apply the same to the real world problems.

Learning Outcomes:

CO1	Outline the concepts of degrees of freedom and constraints
CO2	Identify single degree of freedom systems without damping and with damping
CO3	Analyse multi degree freedom system and continuous systems using iterative techniques.
CO4	Evaluate dynamic response using numerical methods
CO5	Draw mode shapes and determine coefficients
CO6	Apply mode superposition method for seismic analysis.

COURSE OUTLINE:

Unit-1: Concept of degrees of freedom and constraints, Equations of motion, Newton's Law and De Alembert's Principle,

Unit-2: Response of single degree of freedom systems to initial conditions, Response to harmonic excitation, Dynamic amplification factor, Transmissibility, Base Isolation,

Unit-3: Response to non harmonic excitations such as impulse, step loading and blast loading, Duhamel's Integral, Earthquake response analysis, Response spectrum,

Unit-4: Theory of vibration pick – ups, Estimation of dynamic characteristics through experimental investigations,

Unit-5: Multi degree of freedom systems, Orthogonality of mode shapes, Mode superposition method for seismic analysis.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on the Theory of structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:
1. Dynamics of Structures by Anil K. Chopra
2. Dynamics of Structures by Clough and Penzien

TEXT BOOKS / REFERENCES:

1. Structural Dynamics, by Einar N. Strommen
2. Structural Dynamics: Theory and Computation by Mario Paz
3. Structural Dynamics: Theory and Computation by William Leigh, Mario Paz
4. Structural Dynamics For the Practising Engineer, New Edition by H. M. Irvine
5. Dynamics of Structures by J. L. Humour

Course Description

Title: Design of Reinforced Concrete Structures **Code: CE503**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisites: Basic Structural Analysis, Design of Concrete structures
Objective: To familiarize students with special RC structures other than beam, column and slabs.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the governing factors for the design of a given structure.
CO2	**Describe** the step by step procedure for the design of a given member.
CO3	**Develop** the detailing concepts of structures.
CO4	**Identify** the permissible limits for the design of a specific structure.
CO5	**Apply the** codal provision for the design of structures.
CO6	**Understand** the structural behavior of special structures.

COURSE OUTLINE:

Unit-1: Deflections of Reinforced Concrete Beams and Slabs; Estimation of Crack Widths in Reinforced Concrete Beams;

Unit-2: Inelastic Analysis of Reinforced Concrete Beams and Frames;

Unit-3: Design of Shear Walls, Cast-in-Situ Beam-Column Joints, strong-column weak-beam philosophy;

Unit-4: Deep Beams, Chimneys, Ribbed Slabs; Design of Reinforced Concrete Members for Earthquake Resistance, Fire Resistance; Software Applications,

Unit-5: Virendeel Girders, Concrete Trusses.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

TEXT BOOKS / REFERENCES:

1. Design of Reinforced Concrete Structures 1st Edition by N. Subramanian
2. Design of Reinforced Concrete Structures (IS:456-2000) 3rd Edition by N. Krishna Raju
3. Design Of Reinforced Concrete Structures by Ramamrutham
4. Limit State Design of Reinforced Concrete, 2nd Edition by P. C. Varghese
5. Practical Design of Reinforced Concrete Structures 1st Edition by Ghosh

Course Description

Title: Finite Element Methods **Code: CE504**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Structural Analysis

Objective:
The objective of this course is to introduce the fundamentals of finite element methods and apply the same to the real world problems.

Learning Outcomes:

Finite Element Methods	
CO1	**Outline** the concepts used in finite element method
CO2	**Identify** suitable steps to solve a given problem for any shape of structure for static problems.
CO3	**Analyze** the given problem using finite element approach.
CO4	**Describe** the algorithm to solve 2D static problems and solve axisymmetric problems.
CO5	**Determine** the higher order shape functions.
CO6	**Apply** the finite element concept to analyze the real time problem.

Course Content:
Unit 1: Introduction, Matrix-Displacement Formulation, Element Shapes, Nodes, Nodal Unknowns and Coordinate Systems, Shape Functions, Strain-Displacement Matrix.

Unit 2: Assembly Stiffness Equation - Direct Approach, Galerkin's Method, Virtual Work Method, Variational Method.

Unit 3: Applications of FEM in Civil Engineering 1-D Static Problems: Rod, String, Beam, Shaft One-dimensional Formulations; Boundary Conditions; Solution Algorithms;

Unit 4: Descretization; Stress Deformation Analysis 2-D Static Problems: Plane Stress, Plane Strain, Axisymmetric Problems, Stability of Columns and Thin Plates Two-dimensional Formulations; Boundary Conditions; Solution Algorithms.

Unit 5: Langrange's interpolation, Higher order one dimensional elements-Quadratic and cubic element and their shape functions.

Unit 6: Shape function of 2-D quadrilateral element-linear, quadric element Iso- parametric, Sub parametric and Super parametric elements. numerical integration : 1, 2 and 3 gauge point for 1D and 2D cases.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Finite Element Method (will be added from time to time): Digital copy will be available on the JUET server.

Text Books

1. J.N.Reddy, An Introduction to the Finite Element Method, 3rd Edition, Tata McGraw-Hill, 2005.
2. P. Seshu, Text Book of Finite Element Analysis, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

References:

1. C.S. Krishnamoorty, Finite Element Analysis, Tata McGraw-Hill
2. David V. Hutton, Fundamentals of Finite Element Analysis, McGraw Hill
3. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis - Theory and Application, NewYork, McGraw-Hill
4. Irving H.Shames, Clive L. Dym,Energy and Finite Element Methods in Structural Mechanics; New Age International
5. K. J.Bathe, Finite Element Procedures, Prentice-Hall of India, New Delhi, India M.

6. Mukhopadhyay, Matrix, Finite Element, Computer and Structural Analysis, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi, India
7. O. C. Zienkiewicz and Y.K. Cheung, The Finite Element Method in Structural and Soild Mechanics, McGraw Hill, London

Course Description

Title of the course: Concrete Structures Laboratory **Course Code: CE601**
L-T Scheme: 0-0-4 **Course Credits: 2**

Prerequisite: None

Objective: The purpose behind this course is to make the students familiar with the testing of cement and concrete.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the basic properties of building materials.
CO2	**Describe** the standard testing procedures for building materials**.**
CO3	**Develop** the concepts for understanding the physical and mechanical properties of materials.
CO4	**Identify** the significance of different tests and their influence on structural behavior.
CO5	**Apply** the advanced and non-destructive methods of testing to concrete.
CO6	**Design** the concrete mixes for durability.

List of Experiments

PART-A
1. Normal consistency & specific surface area of hydraulic cement.
2. Soundness test & Compressive strength of hydraulic cement.
3. LOI & percentage of silica & alumina of cement or pozzolona.
4. Free lime and sodium oxide & potassium oxide test of cement or pozzolona.
5. Marsh funnel viscosity test and specific gravity test.
6. Air Permeability test on cement mortar.

Assignment: Concrete Mix Design of required grade as per IS Codes.

PART-B
7. Air Entrainment test on freshly prepared concrete
8. Influence of W/C ratio on workability & strength.
9. Compressive strength of concrete of normal & accelerated cured concrete.
10. Non Destructive Testing (NDT) of Concrete.
11. Bend & rebend test of steel bars by Universal testing Machine (UTM).
12. Durability test of concrete by rapid chloride ion permeability test (RCPT).

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Attendance is compulsory in practical which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.

- Internal exam of 30 marks will be conducted as a part of mid semester evaluation. Experiments shall be performed in the field related to course contents.
- The course includes practical, where students have an opportunity to build an appreciation for the concept being taught in lectures.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	**Based on Lab Exercises: 1-6**
P-2		15 Marks	**Based on Lab Exercises: 7-12**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Study material of Building Materials lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

1. 'A Text Book of Building Construction" by Arora, S.P. & Bindra, S.P., Dhanpat Rai & Sons, Delhi.
2. "Building Construction", by Jha, J. & Sinha, S.K., Khanna Publishers, Delhi
3. "A Text Book of Engineering Materials", by Kulkarni, C. J., Ahmedabad Book Depot, Ahmedabad, 1968.
4. "A Text Book of Engineering Construction", by Kulkarni, C. J.Ahmedabad Book Depot, Ahmedabad.
5. "Engineering Materials, by Kumar Sushil, "Standard Publishers Distributors, Delhi

Reference Books:

1. "Building Construction", by Kumar Sushil, Standard Publishers, Distributors, Delhi.
2. "Building Construction, by McKay W.B., "Vol.1 to 4, Orient Longman Ltd., Hyderabad, Bombay, Madras, Delhi, Vol.1 & 2 -1995, Vol. 3-1996, Vol. 4-1998.
3. "A Text Book of Building Construction" by Punmia, B.C., Laxmi Publications, Delhi, Madras.
4."Engineering Materials,", by Singh Surendra, Konark Publishers Pvt. Ltd. 1994.
5. Civil Engg. Materials, TTTI Chandigarh, Tata McGraw- New Delhi

SECOND SEMESTER

Course Description

Title: Solid Mechanics in Structural Engineering **Code: CE505**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Elementary knowledge of structural analysis

Objective:
The objective of this course is to enhance the basic knowledge acquired from structural analysis and to comprehend the constitutive equation of solid structures in complex conditions.

Learning Outcomes:

Solid Mechanics in Structural Engineering	
CO1	**Outline** the fundamental concepts of equilibrium of solid structures.
CO2	**Identify** the strain-stress relations in solid structures.
CO3	**Analyze** the elasticity problem by theory of elasticity.
CO4	**Describe** the plane stress and plane strain condition.
CO5	**Determine** the state of stress of bodies with various conditions.
CO6	**Apply** the failure criteria for various real world problems.

Course Content:

Unit 1: State of stress in a body. Tensor notations, Differential equations of equilibrium,
Unit 2: Invariants of the stress tensor, Theory of strain, Displacement components, strain components and relation between them.
Unit 3: Generalised Hooke's law, Solution of the elasticity problem in terms of displacements, Basic equations of the theory of elasticity, Lame's equations,
Unit 4: Plane problem in Cartesian co-ordinates, Plane problem in polar co-ordinates, Shrink fits,
Unit 5: Rotating disks with uniform thickness, Plate with hole, Torsion in prismatic bars, Saint Venant's method.
Unit 6: Solution of torsion problem in terms of stresses Strain energy, Elastic plastic behavior, Design philosophy, Linear elastic and plastic behavior, Tresca and Von Mises yield criteria, Visco-elastic behavior.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and Unit-6; around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides will be added from time to time: Digital copy will be available on the JUET server.

Text Books

1. Mechanics of Solids by Singh, Arbind Kumar (2007)
2. Solid Mechanics by S.M.A, Kazimi (2003)

References:

1. Advanced Mechanics of Solids by L S, Srinath
2. Mechanics Of Materials Vol-2: The Mechanics of Elastic and Plastic Deformation of Solids and Structural Materials by E.J, Hearn (1997)

Course Description

Title: Design of Steel Structures **Code:** CE506

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:

Objective:
To introduce the students to limit state design of structural steel members subjected to compressive, tensile, and bending loads, including connections. Design of structural member as per the Indian standard.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the properties of the steel section.
CO2	**Identify and design** structural systems fulfilling the design criteria.
CO3	**Analyze** the structural members and their designas per the stability criteria given in IS 800-2007
CO4	**Describe** the significance of ductility in the design of steel structures for flexure, shear, torsion
CO5	**Enumerate** various design principles as per Indian standard codes.
CO6	**Design** different connections for steel structural design members.

Course Content:
Unit-1
Properties of steel: mechanical properties, hysteresis, ductility; Hot-Rolled Sections: compactness and non-compactness, slenderness, residual stresses;

Unit-2
Design of steel structures: inelastic bending – curvature, plastic moments, design criteria - stability, strength, drift;
Unit-3:
Stability criteria: stability of beams – local buckling of compression flange & web, lateral-torsional buckling, the stability of columns - slenderness ratio of columns, local buckling of flanges and web, bracing of a column about weak axis
Unit-4
Method of design - allowable stress design, plastic design, load and resistance factor design; Strength Criteria: beams – flexure, shear, torsion, columns - moment magnification factor, effective length
Unit-5
P-M interaction, bi-axial bending, joint panel zones; Drift criteria: P-Ä effect, deformation-based design
Unit-6:
Connections: types – welded, bolted, location – beam-column, column-foundation, splices.

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.

- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on the Design of Steel Structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Design of Steel Structures Vol.1 by Ram, Chandra
2. Design of Steel Structure by Subramanian. N (2008)
3. Design of Steel Structures by I C, Syal (2005)
4. Design of Steel Structures by L.S, Negi (1997)
5. Design of Steel Structures Vol. 2 by Ram, Chandra

Reference Books/Material:

1. Design of Steel Structures by William T. Segui
2. Design of Steel Structures by B.C, Punmia (1998)
3. Design of Steel Structures by Duggal, S. K. (2000)
4. Principles of Structural Design by E.M.Lui (2006)
5. Behaviour and Design of Steel Structures to EC3 by N S, Trahair (2008)

Course Description

Title: Earthquake Resistant Design of Structures **Course Code CE507**
L-T Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: Mechanics of Solids, Structural Analysis I, Design of Reinforced Concrete Structure

Objective: To understand the fundamentals of designing structures subjected to earthquake loading and the relevant codes of practice.

Learning Outcomes: At the end of the course, the student will be able to design structures subjected to earthquake loading.

Course Outcome	Description
CO1	**Outline** the behavior of buildings and structures during past earthquakes.
CO2	**Identify** various structural systems on the basis of degrees of freedom and perform free vibration analysis.
CO3	**Analyze** the multi storied buildings with seismic coefficient and response spectrum methods.
CO4	**Describe** the significance of ductility in the design of multi-storeyed structures
CO5	**Enumerate** various seismic design principles as per Indian standard codes.
CO6	**Design** reinforced concrete buildings according to capacity design principle.

Course Content:

Unit-1: Behavior of buildings and structures during past earthquakes and lessons learnt goals of earthquake resistant design.

Unit-2: Linear static procedure for seismic load calculation – IS 1893 – 2002

Unit-3: Multimodal and Multidirectional response spectrum analysis

Unit-4: Geotechnical and architectural considerations

Unit-5: Study of IS 13920 – 1993, Earthquake resistant measures in masonry buildings.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.

- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Earthquake Engineering (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Earthquake Resistant Design of Structures by Pankaj Agarwal & Manish Shrikhande, Prentice Hall India.
2. Earthquakes by B. Bolt. Freeman, 1993.
3. Dynamics of Structures by A. Chopra. Prentice-Hall, 1995.
4. Seismic Design of Reinforced Concrete and Masonry Buildings by T. Paulay and M.J.N. Priestley, J. Wiley, 1992
5. B. I.S. Codes No. IS: 1893-2002, IS: 4326-1993, IS: 13920-1993
6. Park & Pauly; Behaviour of RC structure
7. John M.Biggs; Introduction to Structural Dynamics

Reference Books:

1. Dynamics of Structures by Clough R.W. and Penzien J., McGraw-Hill, 2nd edition, 1992
2. Fundamentals of Earthquake Engineering by Newmark N.M. and Rosenblueth E., Prentice Hall, 1971.
3. C V R Murthy - Earthquake Tips, NICEE
4. IITK-GSDMA EQ26 – V -3.0 Design Example of a Six Storey Building

Web References:

[1] https://www.nicee.org/IITK-GSDMA_Codes.php
[2] https://nptel.ac.in/course.html

Journals References:

[1] Journal of Earthquake Engineering
[2] Journal of structural Engineering
[3] Journal of seismology
[4] Journal of Earthquake Engineering & structural dynamics

IS Codes:

- Criteria for earthquake resistant design General provision & Building - IS: 1893 (Part I) - 2002
- Code of Practice for Ductile Detailing of RC Structures - IS: 13920 (1993).
- Code of Practice for earthquake resistant design & Construction of buildings – IS 4326 (1993).
- Improving Earthquake Resistance of Earthen Buildings - IS 13827(1993)-
- Guide lines for Improving Earthquake Resistance low strength masonry buildings - IS:13828 (1993)

Course Description

Title: Theory of Plates and Shells **Code: CE508**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Elementary knowledge of structural analysis

Objective:
The objective of this course is to visualize the concepts of plastic design and understand the fundamental difference between elastic and plastic approach of structural analysis.

Learning Outcomes:

Theory of Plates and Shells	
CO1	**Outline** the fundamental concepts of equilibrium of solid structures.
CO2	**Identify** the strain-stress relations in solid structures.
CO3	**Analyze** the elasticity problem by theory of elasticity.
CO4	**Describe** the plane stress and plane strain condition.
CO5	**Determine** the state of stress of bodies with various conditions.
CO6	**Apply** the failure criteria for various real world problems.

Course Content:
Unit 1: Some results from differential geometry: curves in 3D space – parameterized equation for curves, arc length as a parameter; surfaces - parametric description, curvilinear co-ordinates, **Unit 2:** First and second fundamental forms, principal curvature co-ordinates, derivatives of unit vectors, equations of Gauss and Codazzi.
Unit 3: Membrane theory of shells: equilibrium equations, applications to shells of revolution under axisymmetric loads, applications to cylindrical shells under asymmetric loads, strain-displacement relations, application in calculation of displacements.
Unit 4: Bending theory of shells: kinematic assumptions and strain displacement relations, stress measures and equilibrium equations, constitutive relations, cylindrical shell under axi-symmetric loads, bending of cylindrical shells.
Unit 5: Bending theory of flat plates: thin plates, Kirchoff theory - strain displacement relations, stresses and stress resultants, constitutive equations, equilibrium equations, boundary conditions, derivation of theory from principle of virtual work.
Unit 6: Rectangular plates-solution by double Fourier series, circular plates, edge effects, anisotropic and layered plates, thick plates-Reissner-Mindlin-Naghadi type theories, moderate deflection analysis and buckling of plates.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.

- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and Unit-6; around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides will be added from time to time: Digital copy will be available on the JUET server.

Text Books

1. Mechanics of Laminated Composite Plates and Shells, Theory and Analysis By J.N, Reddy (2004).

References:

1. Theory of Plates and Shells, (Engineering Societies Monographs) By S. Timoshenko, S. Woinowsky-Krieger.
2. Theory of Plates and Shells by Stephen Timoshenko, S. Woinowsky-Krieger Mcgraw-Hill, 1959.

Course Description

Title: CAD laboratory **Course Code: CE602**
L-T-P Scheme: 0-0-4 **Course Credits: 2**

Prerequisite: Structure Analysis-I, Mechanics of Solids, Design of Concrete Structures

Objective:

To develop knowledge of Civil engineering software tools.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** and understand the need for software tools in analysis and design of Civil Engineering Systems
CO2	**Identify** the available open source software tools used for specific problems in Civil Engineering
CO3	**Analyze** the design forces and moments in members.
CO4	**Describe** the load transfer mechanism in structures.
CO5	**Enumerate** and use the latest software tools for Modeling and Analysis
CO6	**Design** various structural components for various types of structures.

List of Experiments

1. Spreadsheet for calculating and drawing shear force and bending moment diagrams of determinate beams.
2. Spreadsheet for designing a singly reinforced beam.
3. Spreadsheet for designing a doubly reinforced beam.
4. Primavera – Creating and analyzing a project – Project 1 part 1
5. Primavera – Creating and analyzing a project – Project 1 part 2
6. Primavera – Creating and analyzing a project – Project 2 part 1
7. Primavera – Creating and analyzing a project – Project 2 part 2
8. STAAD.Pro – Analysis of beams and plane frames
9. STAAD.Pro – Analysis of Trusses
10. STAAD.Pro – Analysis of a building for Gravity loads
11. STAAD.Pro – Analysis of a building for Wind loads
12. STAAD.Pro – Analysis of building for Earthquake load

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Attendance is compulsory in practical which carries marks.

- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Internal exam of 30 marks will be conducted as a part of mid semester evaluation. Experiments shall be performed in the field related to course contents.
- The course includes practical, where students have an opportunity to build an appreciation for the concept being taught in lectures.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	**Based on Lab Exercises: 1-6**
P-2		15 Marks	**Based on Lab Exercises: 6-12**
Day-to-Day Work	Viva	20 Marks	**70 Marks**
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Study material of Civil Engineering Software Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

1. Basic structural analysis by C.S Reddy, Prentice Hall of India Pvt. Ltd.

2. Matrix Method of Analysis of Framed structure by Weaver and Gere, CBS Publication

3.Bhavikatti, S.S, Structural Analysis, Vol.1,& 2, Vikas Publishing House Pvt.Ltd.,NewDelhi4,2014.

4. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing HousePvt.Ltd,NewDelhi-4,2014.

5. Vazrani.V.N and Ratwani, M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.

6. Pandit G.S.andGupta S.P., Structural Analysis–AMatrix Approach, Tata McGraw Hill Publishing Company Ltd.,2006

Reference Books:

1. Advanced Structural Analysis with Computer Applications by Ashok K. Jain., Nemchand and Bros, Roorkee Pub.

2. Theory of Structures by B. C. Punamia

THIRD SEMESTER

Course Description

Title: Seminar-I **Code: CE603**
L-T-P scheme: 0-0-2 **Credits:** 2

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:

1. An ability to function on multidisciplinary areas.
2. To understand the engineering applications in a global, economic, environmental, and societal context.

Learning Outcomes:

Course Outcome	Description
CO1	Develop advanced skills of technical communication in English.
CO2	Communicate confidently and competently in English language on specified topic.
CO3	Develop theory based ideas on particular topic and its importance in engineering.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content

UNIT-1 Identification of Innovative work based upon Literature survey.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Student is expected to do literature survey and carry out development and/or experimentation.

UNIT-4 Student has to exhibit both analytical and practical skills.

UNIT-5 Demonstrate deployment and basic maintenance skills of the respective design project

Teaching Methodology: Seminar is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

Course Description

Title: Dissertation Part-I **Code: CE604**
L-T-P scheme: 0-0-24 **Credits:** 12

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:
1. Students will be able to identify/formulate research the problem for M. Tech. dissertation.
2. Students will be able to write a review paper in the format of standard journal/transactions related to a particular topic.
3. Students will be able to write dissertation/thesis after completion of the work for the degrees of M. Tech.

Learning Outcomes:

Course Outcome	Description
CO1	Interpret data from research papers
CO2	Analyze seminar and presentations
CO3	Development of the theoretical model and computational analysis of the planned work.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Write Dissertation on the basis of research carried out

Course Content

UNIT-1 Literature survey and review, the process of research, Formulation of a research problem, Experimental design –Classification. Theoretical research, Formulating a problem, verification methods, modelling and simulations, ethical aspects, IPR issues, Copyrights and Patenting etc.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Research Problem identification, Probable solutions, verification of the proposed methodology, conclusions. Meaning, Need and Types of research design, Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment

UNIT-4 Quantitative Techniques Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation.

UNIT-5 Research Communication, Writing a conference paper, Journal Paper, Technical report, Dissertation/thesis writing. Presentation techniques, Patents and other IPRs, software used for report writing such as WORD, Latex etc

Teaching Methodology: Dissertation is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

FOURTH SEMESTER

Course Description

Title: Project Seminar **Code: CE605**
L-T-P scheme: 0-0-2 **Credits:** 2

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:

1. An ability to function on multidisciplinary areas.
2. To understand the engineering applications in a global, economic, environmental, and societal context.
3. Student may continue his work taken in Seminar-I or change the topic suitably.

Learning Outcomes:

Course Outcome	Description
CO1	Develop advanced skills of technical communication in English.
CO2	Communicate confidently and competently in English language on specified topic.
CO3	Develop theory based ideas on particular topic and its importance in engineering.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Demonstrate deployment and basic maintenance skills of the respective design project.

Course Content

UNIT-1 Identification of Innovative work based upon Literature survey.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Student is expected to do literature survey and carry out development and/or experimentation.

UNIT-4 Student has to exhibit both analytical and practical skills.

UNIT-5 Demonstrate deployment and basic maintenance skills of the respective design project

Teaching Methodology: Seminar is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do

literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-rources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

Course Description

Title: Dissertation Part-II **Code: CE606**
L-T-P scheme: 0-0-24 **Credits:** 12

Prerequisite: Students must have already studied the basic courses and have explored the various dimensions of structural engineering and its application in Civil Engineering projects.

Objective:
1. Students will be able to identify/formulate research the problem for M. Tech. dissertation.
2. Students will be able to write a review paper in the format of standard journal/transactions related to a particular topic.
3. Students will be able to write dissertation/thesis after completion of the work for the degrees of M. Tech.
4. Student may continue his work taken in Dissertation Part-I or change the topic suitably.

Learning Outcomes:

Course Outcome	Description
CO1	Interpret data from research papers
CO2	Analyze seminar and presentations
CO3	Development of the theoretical model and computational analysis of the planned work.
CO4	Develop writing skill for competence- technical report, design aspects, social issues, etc.
CO5	Conduct conversation practice: face to face and via media.
CO6	Write Dissertation on the basis of research carried out

Course Content

UNIT-1 Literature survey and review, the process of research, Formulation of a research problem, Experimental design –Classification. Theoretical research, Formulating a problem, verification methods, modelling and simulations, ethical aspects, IPR issues, Copyrights and Patenting etc.

UNIT-2 student is required doing an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study.

UNIT-3 Research Problem identification, Probable solutions, verification of the proposed methodology, conclusions. Meaning, Need and Types of research design, Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment

UNIT-4 Quantitative Techniques Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation.

UNIT-5 Research Communication, Writing a conference paper, Journal Paper, Technical report, Dissertation/thesis writing. Presentation techniques, Patents and other IPRs, software used for report writing such as WORD, Latex etc

Teaching Methodology: Dissertation is a course requirement wherein under the guidance of a faculty member, a student is required to do an innovative work with application of knowledge earned while undergoing various courses and laboratories in the course of study. The student is expected to do literature survey and carry out development and/or experimentation. Through this the student has to exhibit both analytical and practical skills.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Unit-1 & Unit-2
P-2	15 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of P-1
P-3	20 Marks	Based on Unit-5 and around 30% from coverage of P-2
supervisor Marks for performance and Attendance	35 Marks	
Report	15 Marks	
Total	**100 Marks**	

Learning Resources:

1. Discussion and seminar materials can be obtained from supervisor, e-resources or from library (will be added from time to time): Digital copy will be available on the JUET server.
2. https://nptel.ac.in/course.html

3. https://scholar.google.com/

Text Book: As prescribed by respective supervisor faculty member

ELECTIVES

Course Description

Title: Stability of Structures **Code:** CE701

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:

Objective:

To impart knowledge on the elastic, inelastic buckling and torsional buckling of structures.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the criteria for the design of structures
CO2	**Identify and design the** stability of various continuous systems.
CO3	**Analyze** the structural members and their design as per the stability criteria in IS code.
CO4	**Describe** the significance of ductility in the design stability of plates for flexure, shear, torsion flexural buckling
CO5	**Enumerate** inelastic buckling and dynamic stability
CO6	**Design** different connections for steel structural design members.

Course Content:

Unit-1

Criteria for design of structures: stability, strength, and stiffness; Classical concept of stability; Stability of discrete systems: linear and nonlinear behavior;

Unit-2

Stability of continuous systems: stability of columns: axial–flexural buckling, lateral bracing of columns, combined axial-flexural-torsion buckling;

Unit-3:

Stability of frames: member buckling versus global buckling, slenderness ratio of frame members;

Unit-4

Stability of beams: lateral-torsion buckling

Unit-5

Stability of plates: axial-flexural buckling, shear flexural buckling, buckling under combined loads;

Unit-6:

Introduction to inelastic buckling and dynamic stability

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.

- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on the Analysis of Structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Stability of Structures, By Z P Bazant and L Cedolin, 1990, Oxford University Press, Oxford.
2. Structural Stability Of Columns And Plates, By N G R Iyengar, 1986, Affiliated East-West Press, New Delhi.
3. Stability Of Structures Principles And Applications By Chai H. Yoo And Sung Lee
4. Stability Analysis And Design Of Structures By M.L. Gambhir

Reference Books/Material:

1. Stability Of Structures: Elastic, Inelastic, Fracture, And Damage Theories By Zdenek P.Bazant, Luigi Cedolin
2. Advanced Mechanics Of Solids And Structures By N. Krishna, Raju (1997)
3. Stability Of Structures By Allied Publishers

Course Description

Title: Plastic Analysis of Structures **Code: CE702**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Elementary knowledge of structural analysis

Objective:
The objective of this course is to visualize the concepts of plastic design and understand the fundamental difference between elastic and plastic approach of structural analysis.

Learning Outcomes:

Composite Materials and Structures	
CO1	**Outline** the fundamental concepts of plastic design.
CO2	**Identify** the hinge formation in various structures.
CO3	**Analyze** the minimum weight design problems.
CO4	**Describe** the Secondary Design Considerations.
CO5	**Determine** the deflection at ultimate loads.
CO6	**Apply** the concepts of design of structures using light gauge metals

Course Content:
Unit 1: Ductility of metals: Concept of plastic design, Overloaded factors, Ultimate load as design coition.

Unit 2: Analysis of Indeterminate Structures: Hinge formation in indeterminate structures, Redistribution of moments, Assumption made for structure subjected to bending only.

Unit 3: Minimum Weight Design: Concept, assumption, Design of frame with prismatic members, Elements of linear programming and its application to minimum weight design problems.

Unit 4: Deflection: Assumption, Calculation of deflection at ultimate loads, Permissible rotations.

Unit 5: Secondary Design Considerations: Influence of direct load, shear local bucking, lateral bucking, repeated loading and brittle fracture on moment capacity.

Unit 6: Design of eccentrically loaded columns. Problem of incremental Collapse, Shake down analysis. Special considerations for design of structures using light gauge metals.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.

- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and Unit-6; around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides will be added from time to time: Digital copy will be available on the JUET server.

Text Books

1. Plastic Analysis and Design of Steel Structures by M. Bill Wong

References:

1. Plastic Analysis by Dr. Colin Caprani

Course Description

Title: Hydraulic Structures **Code: CE703**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Fluid Mechanics

Objective: This course provides in depth knowledge of design for various hydraulic structures.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** advanced topics in the design and construction of dams
CO2	**Identify** Spillways, stilling basin, Intake works, tunnels and penstocks, gates, surge tanks, power house structures.
CO3	**Analyze** types of energy dissipation and their hydraulic design
CO4	**Describe** Theory of Seepage: Seepage force and exit gradient
CO5	**Determine** hydraulic design considerations for cross drainage works
CO6	**Apply** design concepts for Aqueducts, siphon aqueducts, super passages, canal siphons and level crossings.

Course Content:
Unit 1 - Advanced topics in the design and construction of dams: gravity, arch and buttress dams and earthen dams.

Unit 2 - Spillways, stilling basin, Intake works, tunnels and penstocks, gates, surge tanks, power house structures.
Unit 3 - Energy Dissipation Devices: Use of hydraulic jump in energy dissipation, Factors affecting design, types of energy dissipation and their hydraulic design.

Unit 4 - Theory of Seepage: Seepage force and exit gradient, salient features of Bligh's Creep theory, Lane's weighted Creep theory and Khosla's theory for determination of uplift pressures and floor thickness.

Unit 5 - Cross Drainage Works: Definitions, choice of type, hydraulic design considerations.

Unit 6 - Aqueducts their types and design, siphon aqueducts their types and design considerations, super passages, canal siphons and level crossings.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.

- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Applied Mechanics (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. Irrigation Engineering and Hydraulic Structures, by Garg, S.K., Khanna Publishers, 1997.
2. Irrigation Engineering and Hydraulic Structures, by Sahasrabudhe, S.R., Katson Publishers, 1994.
3. Irrigation and Water Power Engineering, by. Punmia, B.C Lakshmi Publications, Delhi.

Course Description

Title: Geo-Environmental Engineering **Code: CE704**

L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite:

Objective:

To know various sources of contaminants and their effects on surface and subsurface, to find out methodology for the disposal of solid waste by engineered design landfills with detection, control and its remediation of subsurface contamination.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** various sources and effects of subsurface contamination.
CO2	**Identify** the physical, chemical and biological characteristics of solid wastes, Soil-waste interaction.
CO3	**Analyze** the laboratory and field evaluation of permeability and Factors affecting permeability
CO4	**Describe** the waste disposal on land on engineered design landfills, waste containment principles, types of barrier materials; Planning and design aspects relating to waste disposal in landfills.
CO5	**Determine** the environmental monitoring around landfills.
CO6	**Apply** engineering properties and geotechnical reuse of waste.

Course Content:

Unit-1
Sources and effects of subsurface contamination; Physical, Chemical and biological characteristics of solid wastes; Soil-waste interaction; Contaminant transport.
Unit-2
Laboratory and field evaluation of permeability; Factors affecting permeability; Waste disposal on land.
Unit-3

Types of landfills: Sitting criteria; waste containment principles; Types of barrier materials; Planning and design aspects relating to waste disposal in landfills, in ash ponds and tailing ponds and in rocks.
Unit-4
Environmental monitoring around landfills; Detection, control and remediation of subsurface contamination;
Unit-5
Engineering properties and geotechnical reuse of waste, demolition waste dumps; Regulations; Case studies.

Teaching Methodology:

- At the start of course, the course delivery pattern, importance of the subject will be discussed.

- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lecture slides and study materials on Geo-Environmental Engineering (will be added from time to time): Digital copy will be available on the JUET server.

TEXT BOOKS / REFERENCES:
1. Geoenvironmental Engineering: Principles and Applications By Lakshmi Reddi, Hilary I. Inyang
2. Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies by Hari D. Sharma, Krishna R. Reddy
3. Geoenvironmental Engineering: Integrated Management of Groundwater and contaminated land edited by Raymond Nen Yong, Hywel R. Thomas
4. Geoenvironmental Engineering and Geotechnics edited by Qiang He, Shui-Long Shen
5. Geoenvironmental Engineering By A.M.O. Mohamed, H.E. Antia
6. Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate, and Mitigation By Raymond N. Yong

Course Description

Title: Modelling, Simulation and Computer Applications **Code: CE705**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: None

Objective: This course is designed to explain the concept of modeling, optimization and simulation.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** various systems approach - concept and analysis.
CO2	**Identify** systems for modelling of wastewater management
CO3	**Analyze** pesticide management problems; optimization model for planning municipal wastewater treatment.
CO4	**Describe** Linear programming models, solution and sensitivity analysis
CO5	**Determine** integer programming to municipal solid waste management
CO6	**Apply** modeling concepts to Transportation models. Dynamic programming models- application to land use planning and air pollutant emission control.

Course Content:
Unit 1 - Systems approach - concept and analysis. Problems formulation, model construction and deriving solution from models.

Unit 2 - Modelling of wastewater management systems- model formation and solution.
Unit 3 - Modelling of pesticide management problems; optimization model for planning municipal wastewater treatment.

Unit 4 - Linear programming models, solution and sensitivity analysis. Separable and integer programming - application to multi-objective planning.

Unit 5 - Application of integer programming to municipal solid waste management.

Unit 6 - Transportation models. Dynamic programming models- application to land use planning and air pollutant emission control.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.

- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Applied Mechanics (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. Handbook of Environmental and Ecological Modelling, Halling-Sorensen B., Nielsen S.N. and Jorgensen, S.E., Lewis Publishers Inc., 1995.
2. Fundamentals of Atmospheric Modelling, Jacobson Mark Z., Kluer Academic Press, 2002.
3. An Introduction to Water Quality Modelling, James A. (Ed), (2nd Ed.), 1992.
4. Techniques for Environmental System Analysis - R.H.Pantell Wiley, NY, 2001.
5. System Analysis and Design – RJ Aguilar, Prentice Hall, Englewood Cliffs, N.J., 1993.

Course Description

Title: Engineering Design Optimization and Reliability **Course Code: CE706**
L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites:

Objective: This course is designed to introduce graduate students to concepts and applications of structural reliability and design optimization.

Learning Outcomes:

CO1	**Outline** first- and second-order estimates of failure probabilities of engineered systems
CO2	**Identify** sensitivities of failure probabilities to assumed parameter values
CO3	**Analyse** and measure the relative importance of the random variables associated with a system.
CO4	**Describe** and update reliability estimates based on new observational data.
CO5	**Demonstrate** the relative advantages and disadvantages of various analytical reliability methods, as well as Monte Carlo simulation.
CO6	**Explain** and use reliability tools to calibrate simplified building codes.

Course Content:

Unit-1: Introduction to Design Optimization; Optimal Design Problem Formulation; Graphical Optimization and Basic Concepts.

Unit-2: Optimum Design Concepts: Optimality Conditions; Optimal Design with MATLAB Numerical.

Unit-3: Methods for Unconstrained Design Optimization; Numerical Methods for Constrained Design Optimization; Practical Applications of Optimization.

Unit-4: Genetic Algorithm for Optimum Design; Multi-objective Optimum Design Concepts and Methods. Fundamentals of probability theory; Common probabilistic models.

Unit-5: General component reliability; First-order second-moment methods; First and Second-order reliability method.

Unit-6: Importance measures and parameter uncertainty; Sampling techniques; Surrogate Modeling. Development of reliability based design codes; System reliability.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Theory of structures (will be added from time to time): Digital copy will be available on the JUET server.

Books and references:

1. Jasbir S. Arora, “Introduction to Optimum Design”, 3rd Ed., Academic Press 2012.
2. Achintya Halder and Sankaran Mahadevan, “Probability, Reliability, and Statistical Methods in Engineering Design”, John Wiley. 2000
3. O. Ditlevsen, and H. O. Madsen, “Structural Reliability Methods”, Internet Edition 2.3.7, John Wiley. http://www.web.mek.dtu.dk/staff/od/books.htm 2007
4. A.H.S. Ang and W. H. Tang, “Probability Concepts in Engineering Planning and Design”, Vol. I : Basic Principles, Wiley. 1975
5. R. E. Melchers, “Structural Reliability Analysis and Prediction”, 2nd Ed., Wiley 1999

Course Description

Title: Fracture Mechanics in Quasi-Brittle Materials **Course Code: CE707**
L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites:

Objective: To introduce the mechanics of fracture and their applications to anisotropic and heterogeneous quasi-brittle materials.

Learning Outcomes:

CO1	**Outline** basic modes of fracture.
CO2	**Identify** energy release rate, Griffith's energy balance criterion, Crack resistance, Stress intensity factors, Small scale yielding, plastic zone corrections.
CO3	**Analyse** Trends in Fracture of quasi-brittle materials, Fracture process zone, Size effect: Sources, experimental evidence, statistical and energetic size effect.
CO4	**Describe** application of fracture mechanics to concrete structures.
CO5	**Demonstrate** Conventional methods of fatigue analysis, Fatigue crack propagation approach, Crack propagation models for constant and variable amplitude loading, Overload effect, Crack closure.
CO6	**Explain** Finite elements in fracture mechanics.

Course Content:

Unit-1: Basic concepts: Basic modes of fracture, Elasticity solution to infinite and finite plate with a crack: Westergaard complex function and Muskhelishvili potential, Effect of free boundary, 3-Dimensional crack problems.

Unit-2: Linear elastic fracture mechanics(LEFM) based design concepts: Energy release rate, Griffith's energy balance criterion, Crack resistance, Stress intensity factors, Small scale yielding, plastic zone corrections. Elastic plastic fracture mechanics (EPFM) based design concepts: J-integral, Crack tip opening displacement, Crack growth resistance concepts

Unit-3: Introduction to fracture mechanics in Quasi-brittle material: Trends in Fracture of quasi-brittle materials, Fracture process zone, Size effect: Sources, experimental evidence, statistical and energetic size effect. Non-linear fracture mechanics: Fictitious and Effective elastic crack approach, Nonlocal continuum modelling of damage localization

Unit-4: Application of fracture mechanics to concrete structures: Size effect on nominal strength, Tension of reinforced concrete members, Bending of reinforced concrete members,

Shear in reinforced concrete beams, Fibre-reinforced concrete, Bi-material interface, Concrete dams.

Unit-5: Fatigue and fracture in concrete: Introduction, Conventional methods of fatigue analysis, Fatigue crack propagation approach, Crack propagation models for constant and variable amplitude loading, Overload effect, Crack closure.

Unit-6: Finite elements in fracture mechanics: Modelling of crack tip singularity, Approaches for the extraction of stress intensity factor, Discrete and smeared crack approach, Application to problems of LEFM and EPFM.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Theory of structures (will be added from time to time): Digital copy will be available on the JUET server.

Books and references:

1. Broek, D.,Springer, “Elementary Engineering Fracture Mechanics”, 3rd Ed., 1982.
2. Kumar, P., “Elements of Fracture Mechanics”, Wheeler Publishing. 1999
3. Anderson, T.L., “Fracture Mechanics: Fundamentals and Applications”, 3rd Ed., CRC Press. 2005
4. Shukla, A., “Practical Fracture Mechanics in Design”, 2nd Ed., CRC Press. 1989
5. Shah, S. P., Swartz, S. E. and Ouyang, “Fracture Mechanics of Concrete: Applications to Concrete, Rock and other Quasi-brittle Materials”, C., John Wiley. 1995
6. Bazant, Z. P., and Planas, J., “Fracture and Size Effect in Concrete and Other Quasi-brittle Materials”, CRC Press. 1997

Course Description

Title of the course: Design of Bridge Substructures **Course Code: CE708**

L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: Foundation Engineering

Objective: To introduce the behavior and design of bridge substructures.

Learning Outcomes:

CO1	**Outline** hydraulic calculations.
CO2	**Identify,** analysis and design of piers and pier caps.
CO3	**Analyse** forces on seismic restrainers.
CO4	**Describe** analysis and design of abutments.
CO5	**Demonstrate** design of well foundations.
CO6	**Explain** the design of pile foundations.

Course Content:

Unit-1: Hydraulic calculations related to bridge design.

Unit-2: Analysis and design of piers and pier caps.

Unit-3: Seismic restrainers.

Unit-4: Analysis and design of abutments.

Unit-5: Analysis and design of well foundations.

Unit-6: Analysis and design of pile foundations.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.

- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Theory of structures (will be added from time to time): Digital copy will be available on the JUET server.

Books and references:

1. Vijay Singh, “Wells and Cassions” Nem Chand & Sons. 1981.
2. S. Saram, “Analysis and Design of Substructures”. 2012
3. Ponnuswamy, “Bridge Engineering”. 1986
4. Rakshit, “Design and Construction of Highway Bridges”. 2004
5. D. J. Victor, “Essentials of Bridge Engineering”. 2001

Course Description

Title: Soil Structure Interaction **Code: CE709**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite:

Objective:

To know various sources of contaminants and their effects on surface and subsurface, to find out methodology for the disposal of solid waste by engineered design landfills with detection, control and its remediation of subsurface contamination.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** pressure distribution beneath the shallow and deep foundation on soil.
CO2	**Identify** limit analysis of rafts and foundations.
CO3	**Analyze** the soil structure interaction studies pertaining to buried structures
CO4	**Describe** the analysis and design of deep foundations.
CO5	**Determine** the effect of pressure distribution according to variation in footing and soil.
CO6	**Apply** the modern trends in the design of earth retaining structures

Course Content:
Unit-1
Contact pressure distribution and foundation models.
Unit-2
Limit analysis of rafts and foundations,
Unit-3
Soil structure interaction studies pertaining to buried structures
Unit-4
Analysis and design of deep foundations.
Unit-5
Modern trends in the design of earth retaining structures and case studies

Teaching Methodology:

- At the start of course, the course delivery pattern, importance of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.

- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lecture slides and study materials on Soil Structure Interaction (will be added from time to time): Digital copy will be available on the JUET server.

TEXT BOOKS / REFERENCES:

1. Soil-Structure Interaction: Numerical Analysis and Modelling By J.W. Bull, CRC Press, 09-Dec-1993.
2. Soil-Structure Interaction Of Buildings With Different Stiffness By Bharti, Chandan (2010).
3. Seismic Soil Structure Interaction: New Evidence and Emerging Issues, Geotechnical Earthquake Engineering and Soil Dynamics, By Gazetas G., Mylonakis G. (1998). ASCE II, 1119–1174.
4. Dynamic Soil Structure Interaction, Prentice Hall Englewood Cliffs, By Wolf J.P., (1985). New Jersey.

Course Description

Title: Design of Industrial Structures **Code: CE710**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Design of Concrete Structures and Design of Steel Structures

Objective:

The objective of this course is to acquaint the student with knowledge about different types of industrial structures, their analysis and design for different conditions as per codal provision.

Learning Outcomes:

Design of Industrial Structures	
CO1	**Outline** the concepts used in planning of industrial structures.
CO2	**Identify** suitable steps to design steel structural members.
CO3	**Analyze** the effects of load combinations on structures.
CO4	**Describe** the design stepd involved in complex structures like chimneys, cooling towers, bunkers and Silos.
CO5	**Determine** the design parameters affecting special foundations.
CO6	**Apply** the basic design concepts developed throughout the course for any problem in hand.

Course Content:

Unit 1: Planning of industrial structures, Design of braced and unbraced industrial portals in steel.

Unit 2: Design of gantry girder, Design of single and multi bay industrial sheds in steel and concrete. Design of tie rods, sag rods, girt angles and purlins under action of dead, live and wind loads.

Unit 3: Design of chimneys under combination of dead load, wind load and temperature stresses. Design of masts and cooling towers.

Unit 4: Design of storage structures like bunkers and silos using Airy's and Jansen's theories.

Design of large span roof structures and suspension roof structures,

Unit 5: Machine foundations, Design of foundations for impact and rotary and reciprocating type machines.

Unit 6: Analysis and design of Virendeel Girders.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Design of Industrial structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Books

1. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, "Design of Steel Structure", 2nd Edition, Lakshmi Publishers, 1998.
2. Punmia B.C, Ashok Kr. Jain, Arun Kr. Jain, "RCC Designs (Reinforced Concrete Design)", 10th Edition, Lakshmi Publishers, 2006.
3. Ram Chandra, "Design of Steel Structures", 12th Edition, Standard Publishers, 2009.

References:

1. Advanced Reinforced Concrete Design, By N. Krishna Raju (CBS Publishers & Distributors) 2005.
2. Design of Steel Structures, By Ram Chandra and Virendra Gehlot vol-II, 2007.
3. Design of Steel Structures, By Duggal - Tata McGraw-Hill publishers – 2010

Course Description

Title: Recent advances in Construction materials **Code:** CE711
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Building materials and construction

Objective:
To introduce the advanced building materials used in the construction industry or being studied at the research level.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the various properties and uses of construction materials.
CO2	**Describe** the behavior of materials.
CO3	**Develop** the concepts of construction materials for appropriate field applications as per IS code requirements.
CO4	**Identify** the requirements of construction materials as per IS codes.
CO5	**Demonstrate** the structural aspects of different materials and the technicalities involved in construction methods.
CO6	**Apply** the concepts developed for the planning and construction of buildings.

Course Content:

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Unit 1: Foams and light weight materials, fibre reinforced concrete. Types of fibres, workability, mechanical and physical properties of fibre reinforced concrete,

Unit 2: Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete,

Unit 3: Concrete at high temperature, High strength concrete, changes in concrete with time, corrosion of concrete in various environments, corrosion of reinforcing steel, electro chemical process, measures of protection,

Unit 4: Ferro-cement, materials and properties polymers Civil Engineering Polymers, fibres and composites, fibre reinforced plastic in sandwich panicles, modelling.

Unit 5: Architectural use and aesthetics of composites. Adhesives and sealants. Structural elastomeric bearings and resilient seating.

Unit 6: Moisture barriers, polymer foams and polymers in building Physics, Polymer concrete composites.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Recent advances in Construction materials (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Interscience Publication by Broutman.A Wiley John Wiley & sons New York, 1996.
2 Engineering Materials by Rangwala S C Charotar Publishing house , Anand, 1985.
3. Weather Head R G “FRP Technology” Applied Science Publishers Ltd , London ,1998.
4. Civil Engineering Materials by Raina K B Tata McGraw- Hill Publishing Company Ltd, New Delhi, 1999.
5. Engineering Materials .by Budinski KG, Prentice Hall of India, New Delhi, 1985.

Reference Books/Material:

1. Concrete, Prentice-Hall, by P. K. Mehta, P J M Monteiro, New Jersey
2 Handbook of Concrete Mixes, Special Publications No 24 BIS New Delhi
3. EFNAARC Guidelines on SCC
4. ACI Special Publications
5. IS Specifications

6. Advances in Construction Materials 2007 by Christian U. Grosse.
7.Advanced Civil Infrastructure Materials Science, Mechanics and Applications by H Wu

Course Description

Title: Pre-stressed Concrete Design **Code: CE712**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Structural Analysis, Design of Concrete Structures

Objective:
Develop professional level competence in the design of commonly used prestressed concrete structures.
Learning Outcomes:

Course Outcome	Description
CO1	**Outline** of the methods of pre-stressing and the materials used.
CO2	**Identify** the governing factors for design of pre-stressed member.
CO3	**Analyze** a pre-stressed concrete section and estimate the losses.
CO4	**Describe** the flexural and shear properties of pre-stressed members.
CO5	**Determine** the dimension and design values for pre and post tensioned beams.
CO6	**Apply** the principles developed in the course for analysis and design of complex pre-stressed structures.

Course Content:
Unit 1: Definition, Basic Principles, Types of prestressing, Systems of prestressing, Loss of prestress, materials used, Advantages and disadvantages.

Unit 2: Critical load condition, Permissible stresses, Various suggested methods of design, Dimensionless Design variables, Solution of equations,

Unit 3: Design Procedure based on flexure, Minimum weight design, Cable layout and profile of tendons, Design by load balancing method, Code provisions. Allowable stress considerations, Non-dimensionalised allowable stress equations and their solution, Shrinkage Stresses.

Unit 4: Two span continuous beams and their analysis, Application of moment distribution method, Design of continuous beams, Continuous beams with variable section.

Unit 5: One way and two way slabs, Beam and slab construction, Principal Stresses, failure due to shear, combined bending and shear, Bond, Prestressing cable at the centroidal axis, Symmetric multiple cable, cable with eccentricity, Inclined cables, Spalling and bursting stresses.

Unit 6: Compression members, Tension members, Prestressed Concrete Pavements, Folded plates and Shells, Arches, Dams, Rigid frames, Cylindrical tanks.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Pre-stressed Concrete Structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Modern Prestressed Concrete Design by G. S. Ramaswamy Pitman.
2. Design of Pre-Stressed Concrete Structures by Lin, T.Y. And Burns, N.H
3. Design Of Pre-Stressed Concrete Structures by Krishna Raju

Reference Books:

1. Pre-Stressed Concrete, by Pandit & Gupta, CBS
2. Design of Pre-stressed Concrete Structures, by T.Y. Lin, Asia Publishing House, 1955.
3. Pre-Stressed Concrete: A Fundamental Approach,by Edward Nawy, prentice hall, New Jersey
4. Prestressed Concrete Design, Second Edition by M.K. Hurst, CRC Press.
5. Design of Prestressed Concrete by R. I. Gilbert, Neil C. Mickleborough CRC Press.

6. Prestressed Concrete Design by Melvin Keith Hurst Chapman and Hall.

Course Description

Title: Composite Materials and Structures **Code: CE713**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Elementary knowledge of building materials

Objective:
The objective of this course is to understand the development of composites as construction materials, their mechanical properties and applications in construction industry.

Learning Outcomes:

Composite Materials and Structures	
CO1	**Outline** the fundamental concepts of composite material.
CO2	**Identify** the different types of materials and their properties to be used as composites.
CO3	**Analyze** the role of fibres in composites.
CO4	**Describe** the characterization techniques available to study composites.
CO5	**Determine** the elastic properties of composite laminates.
CO6	**Apply** the concepts of idealization to the study of composites used in general construction industry..

Course Content:
Unit 1: Definition of Composite Materials, Classification of Composite Materials, Role of matrix in composite materials,

Unit 2: Polymer matrices, Classification of Polymer, Metal Matrices, Ceramic matrices, Comparison of polymer matrix, Metal matrix and ceramic Matrix,

Unit 3: Role of fibres in composites, Comparison of Fibres, Role of interface in the fibre matrix composite.

Unit 4: Characterization of composites, Analysis of an Orthotropic Lamina and laminated Composites,

Unit 5: Elastic properties of Unidirectional Laminate, cross ply laminate, Angle ply laminates, Short fibre composite materials, Experimental Characterization of Composites.

Unit 6: Composite Structures: need, behaviour, idealization and construction. Interaction between composite components. Component method and idealization. Codal specifications for composite structures, case study.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.

- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2 & Unit-3and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and Unit-6; around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Composite Materials and Structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Books

1. Mechanics Of Composite Materials And Structures by Madhujit, Mukhopadhyay (2009)

References:

1.Structural Composite Materials By F.C. Campbell
2.Composite Materials And Structures By P. K. Sinha

Course Description

Title: Analysis and Design of Tall Buildings **Course Code: CE714**
L-T Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: None

Objective: To explain the fundamentals of the behavior of tall buildings and the methods used for the analysis and design of such structures.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** and understand principles of planning of tall structures
CO2	**Identify** the criteria for design of various structural systems
CO3	**Analyze** the design forces and moments in tall structures with shear walls.
CO4	**Describe** the load transfer mechanism in structures.
CO5	**Apply** codal provisions for fire protection in tall buildings.
CO6	**Design** tall buildings with different structural systems.

Course Content:

Unit-1: Principles of Planning

Unit-2: Types of structural systems for tall buildings, Shear Walls and their arrangement

Unit-3: Loads on Tall Buildings, Codal Provisions

Unit-4: Analysis of Tall Buildings with and without Shear Walls

Unit-5: Design of Tall Buildings.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Text Books / References:

1. Reinforced Concrete Design Of Tall Buildings By Bungale S. Taranath
2. High Rise Building Structures By Schuellar, W
3. Structural Analysis & Design Of Tall Buildings By B.S. Taranath
4. Handbook of Concrete Structures by M. Fintal.
5. Tall Building Structures: Analysis & Design By B. Stafford Smith & A. Coule
6. Advances in Tall Buildings, CBS Publishers and Distributors Delhi, 1986.

Course Description

Title of the course: **Structural Health Monitoring** Course Code: CE715

Course Credits: 3

Prerequisites: Structural Dynamics

Objective: To understand the different methods of Structural Health Monitoring.

Learning Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.

2. Assess the health of structure using static field methods.

3. Assess the health of structure using dynamic field tests.

4. Suggest repairs and rehabilitation measures of the structure

Course Content:

UNIT – I Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT – II Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT – III Introduction to Static Field Testing and Dynamic Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement. Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT – IV: Durability aspects related to health monitoring, Corrosion principles, types of corrosion, corrosion testing, corrosion prevention techniques, prediction of corrosion behavior.

UNIT – V Introduction to Repairs and Rehabilitations of Structures: Case Studies piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus_Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006
2. Health Monitoring of Structural Materials and Components Methods with Applications,
3. Douglas E Adams, John Wiley and Sons, 2007.
4. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
5. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc,2007
6. Corrosion Engineering, Mars G. Fontana, McGraw Hill Education (India) Pvt. Ltd.

Course Description

Title: Repair and Retrofitting of Structures **Course Code: CE716**
L-T Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: None

Objective: To develop skills to understand the techniques of retrofitting of structural elements.

Learning Outcome:

Course Outcome	Description
CO1	**Outline** the principles of retrofitting.
CO2	**Describe** the criteria for repair and retrofitting.
CO3	**Apply** the non-destructive techniques for assessment of distressed concrete structures and its repair techniques.
CO4	**Identify** and describe the parameters affecting the durability of concrete.
CO5	**Develop** and design the retrofitting program of bridges and dams and heritage structures.
CO6	**Demonstrate** different special techniques of retrofitting including base isolation as a method of seismic retrofitting

Course Content:

Unit-1: Principles of retrofitting

Unit-2: Criteria for repair and retrofitting

Unit-3: Design considerations, codes of practices for repair and retrofitting

Unit-4: Retrofitting of bridges and dams and heritage structures

Unit-5: Retrofitting of structures by seismic base isolation, case studies of retrofitting of structures.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2

Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Text Books / References:

1. Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures by M.Fujita, T.Takanashi, K.Kuzume, T.Ueda, A.Kobayashi, D.Joray, M.Diggelmann, C.Bob, S.Dan, C.Badea, A.Gruin, L.Iures, A.B.Ajdukiewicz, J.S.Hulimka, G.Hong, Y.Chung, H.Chung, I.Vilonen P.Stefanovic.
2. Concrete Repair, Rehabilitation and Retrofitting II: 2nd International Conference on Concrete Repair, Rehabilitation and Retrofitting, ICCRRR-2, 24-26 November 2008, Cape Town, South Africa, Published: November 13, 2008 by CRC Press Content:476 Pages Editor(s):Mark G. Alexander, Hans-Dieter Beushausen, Frank Dehn, Pilate Moyo
3. Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures by International Association for Bridge and Structural Engineering, Publisher IABSE, 2010

Course Description

Title: Construction methods and equipment **Code:** CE717

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:

Objective:

- Please become familiar with the types of construction equipment and their capabilities.
- Understand the basic principles and terminology of project management and construction methods.
- Skills development for successful job performance, especially communications, both written and verbal.
- Ethics comprehension.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the factors affecting the selection of equipment
CO2	**Identify and** utility of construction engineering fundamentals,
CO3	**Analyze** the production output and costs
CO4	**Describe** the activities in methods of construction. .
CO5	**Enumerate** various seismic design principles as per Indian standard codes.
CO6	**Design and making** of concrete in the RMC plant and their transport to the construction sites.

Course Content:

Unit-1:
Factors affecting selection of equipment, technical and economic
Unit-2:
construction engineering fundamentals,
Unit-3:
Analysis of production outputs and costs
Unit-4:
characteristics and performances of equipment for Earthmoving
Unit-5:
Erection, Material transport, Pile driving, Dewatering,
Unit-6
Concrete construction (including batching, mixing, transport and placement) and Tunnelling.

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.

- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Construction methods and equipment (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Construction Planning, Equipment, and Methods by Robert L, Peurifoy (2005)
2. Construction Equipment and Methods: Planning, Innovation, Safety by Leonhard E. Bernold

Reference Books/Material:

1. American Society of Civil Engineers (ASCE), Journal of Construction Engineering and Management (on the shelves at the Seaver Science Library). Day, D.A., Construction Equipment Guide, John Wiley, 1995.
2. Griffis, F.H., and Farr, J.V., Construction Planning for Engineers, McGraw Hill, 2000.
3. Harris, F.C., Modern Construction Equipment and Methods, Longman Scientific &Technical, 1994.
4. Harris, F.C., Construction Plant Excavating, and Material Handling, Equipment methods, Garland, 1981.
5. Harris, F.C., Ground Engineering Equipment and Methods, McGraw Hill, 1983.
6. Nunnally, S.W., Construction Methods and Management, Third Edition, Prentice-Hall, 1992.
7. Parker, A.D., Barrie, D.S., and Snyder, R.M., Planning, and Estimating Heavy Construction, McGraw Hill, 1984.

Course Description

Title of the course: Structural Vibration Control **Course Code: CE718**
L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: Structural Dynamics

Objective: To introduce the structural vibration control techniques to reduce the level of vibration and increase safety and occupant comfort.

Learning Outcomes:

CO1	**Outline** Quantitative Description of Vibration, Methods of Vibration Control, Basic System Parameters.
CO2	**Identify** Balancing Machines, Field Balancing, Balancing of Flexible Rotors, Vortex Induced Vibration, Detuning and Decoupling.
CO3	**Analyse** Damping Models and Measures.
CO4	**Describe** Stress-strain relationship, Complex Modulus, Frequency temperature dependence of complex modulus, Representation of Complex Stiffness, Free Layer Damping, Constrained Layer Damping, Viscoelastic Joints, Bonded Rubber Springs.
CO5	**Demonstrate** design of Dynamic Vibration Absorbers.
CO6	**Explain** different Vibration Isolators and Active Vibration Control measures.

Course Content:

Unit-1: Overview of Vibration Control: Introduction, Quantitative Description of Vibration, Methods of Vibration Control, Basic System Parameters.

Unit-2: Vibration Reduction at the Source: Introduction, Balancing, Balancing of Rigid Rotors, Balancing Machines, Field Balancing, Balancing of Flexible Rotors, Vortex Induced Vibration, Detuning and Decoupling.

Unit-3: Vibration Control by Structural Design: Damping Models and Measures, Origin of Structural Damping, Damping-Stress Relationship, Selection Criteria for Linear Hysteretic Materials, Combined Fatigue-Strength Damping Criteria, Design for Enhanced Material Damping.

Unit-4: Visco-elastic Materials for Vibration Damping: Standard Linear Solid – constitutive models, Stress-strain relationship, Complex Modulus, Frequency temperature dependence of

complex modulus, Representation of Complex Stiffness, Free Layer Damping, Constrained Layer Damping, Viscoelastic Joints, Bonded Rubber Springs.

Unit-5: Dynamic Vibration Absorbers: Introduction, Dynamic Vibration Neutralizers, Self-tuned Pendulum Neutralizer, Optimum Design of Damped Absorbers, Auxiliary Mass with Damper, Gyroscopic Absorber, Impact Absorber, Absorbers attached to Continuous Systems, Special types of Absorbers, Applications of DVA.

Unit-6: Vibration Isolators: Introduction, Isolators with Complex Stiffness, Isolators with Coulomb Damping, Three Element Isolators, Two-stage Isolators, Suspension systems, Applications of Isolators. **Active Vibration Control:** Introduction to Closed Loop Control, Classical Control System, Piezoelectric Sensors and Actuators, Vibration Control of Flexible Beam, Energy Harvesting System.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Theory of structures (will be added from time to time): Digital copy will be available on the JUET server.

Books and references:

1. Active and Passive Vibration Control, Mallik and Chatterjee, 2014
2. Mechanical Vibrations, Den Hartog, 1956
3. Moheimani and Fleming – Piezoelectric Translators for Vibration Control and Damping, Spiringer
4. L. Meirovitch, Dynamics and Control of Structures
5. A. Preumont, Vibration Control of Active Structures : An Introduction, Kluwer Academic
6. D. J. Inman, Vibration with Control, Wiley

Course Description

Title: Formwork for Concrete Structures **Code: CE719**
L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Structural Analysis, Design of Steel Structures

Objective: To learn and Discuss the design parameters of beam formwork components of column formwork.

Learning Outcomes:

Course Outcome	**Description**
CO1	Explain the various materials required for formwork
CO2	Analyse the loads on formwork
CO3	:Design the formwork systems
CO4	Identify the methodology to prepare formwork systems
CO5	Discuss the applications of special forms and their safety
CO6	:Describe the importance of scaffolding

Course content:

Unit-1: INTRODUCTION:

Formwork, scaffolding systems, types of formwork, Construction planning and site constraints, Materials and construction of the common formwork and false work systems, Planning for maximum reuse – Economical form construction, Special and proprietary forms.

Unit-2LOADS AND PRESSURES:

Pressures on Formwork - Concrete density – Height of discharge – Temperature – Rates of Placing – Consistency of concrete – Live loads and wind pressure – Vibration, Hydrostatic Adjustment for non-standard condition.:

Unit-3:SHORING, FORMWORK AND ACCESSORIES DESIGN:

Simple wood stresses – Slenderness ratio – Allowable loads – Tubular steel shores - Patented shores – Site Preparation - Size and spacing – Steel Tower Frames – Safety practices – Horizontal shoring for multi-levels – More concentrated shore loads. Basic simplification – Beam formulae – Allowable stresses – Deflection bending lateral stability – Shear, Bearing – Examples of wall forms – Slab forms – Beam form – Ties, Anchors and Hangers – Column forms – Examples of each.

Unit-4: SPECIAL FORMS AND FORMWORK SAFETY:

The use and applications of special forms - slip form, tunnel form, climbing form, flying form, Sequence of construction, stripping of formwork, Safe use of formwork.

Unit-5: SCAFFOLDING:

Types of scaffolds - Putlog and Independent scaffold – Single pole scaffolds – Fixing ties – Spacing of ties - Plan Bracing – Knots – Safety nets – General safety requirements – Precautions – Truss, Suspended – Gantry and system scaffolds.

Teaching Methodology: The course will be covered through lectures supported by tutorials. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% fromcoverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage ofTest-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	100 Marks	

Learning Resources:

Lectures notes, Tutorials, slides (will be added from time to time), Digital copy will be available on the JUET server.

Text Books:

1. Hurd, M.K., Formwork for Concrete, 7th Edition, American Concrete Institute, 2005.

2. Robert L. Peurifoy and Garold D. Oberlender, Formwork for Concrete., Structures, 4thEdition, McGraw Hill Professional, 2010

Reference Books:

1. Austin, C.K., Formwork for Concrete, Cleaver–Hume Press Ltd., 1996.

2. Formwork - A guide to good practice, The Concrete Society, 3rd Edition, 2012.

3. Guide to Formwork for Concrete (ACI 347-04), American Concrete Institute, 2004.

4. Michael P. Hurst, Formwork, Construction Press, 1997.

5. Robert Ratay, Temporary Structures in Construction, 3rd Edition McGraw Hill Professional, 2012.

6. Tudor Dinescu and Constantin Radulescu, Slipform Techniques, Abacus Press, 1992.

CODES:

1. IS:14687-1999, Guidelines for falsework for concrete structures, Bureau of Indian Standards, 1999.

Course Description

Title: Advanced Steel Design **Code: CE720**
L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:

Objective:
To introduce the students to the importance of plastic analysis and design, design of various advanced steel structures.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the plastic analysis and design of different steel structures members.
CO2	**Identify** and analyze the member forces using the tension coefficient method
CO3	**Analyze** the design of the industrial structure applied to wind forces.
CO4	**Describe** the procedures follow in design advanced steel structure
CO5	**Enumerate** various design concept and configuration of different types of steel tanks as per Indian standard codes
CO6	**Design** different connections for steel structural design members.

Course Content:
Unit-1
Plastic Design, Plastic Hinge, Plastic Collapse Load, Plastic Analysis of Frames;

Unit-2
Wind Loads on Industrial Buildings, Braced and Unbraced Industrial Frames;
Unit-3:
Transmission Line Towers, Analysis by Tension Coefficients, Member selection
Unit-4
Steel Tanks and Stacks,
Unit-5
Different Configurations and components of Elevated Circular Tanks
Unit-6:
Steel Stacks, Design Considerations; Design in Light Gauge Steel; Aluminum Structures; Residual Stresses

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.

- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Advanced design of steel (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Advanced Steel Structures Design by Segui, William T
2. Advanced Analysis in Steel Frame Design by Andrea E. Surovek,
3. Advanced Steel Structures by Wei Lu Pentti Mäkeläinen

Reference Books/Material:

1. Advanced Analysis and Design for Fire Safety of Steel Structures, Series: Advanced Topics in Science and Technology in China by Li, Guoqiang, Wang, Peijun
2. Advanced Analysis and Design of Steel Frames by Gou-Qiang Li, Jin-Jin Li
3. Salmon, C.G., Johnson, J.E., and Malhas, F.A. Steel Structures – Design and Behavior, 5th Ed., Harper Collins, 2009.
4. AISC, Steel Construction Manual, AISC, 14 th Edition, 2011.

Course Description

Title: Wind Engineering **Code: CE721**

L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: Nil

Objective:

1. To learn basic principles of wind engineering as applied to civil engineering structures, including boundary layer wind tunnel testing.
2. To be able to compute design wind speeds, mean wind pressures and loads for a typical building using IS code provisions.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the basic need and significance of wind engineering for design of structures.
CO2	**Identify** mean velocity and turbulence characteristics in different terrains.
CO3	**Describe** aerodynamics of bluff bodies and stream lined bodies.
CO4	**Develop** understanding on concepts of basic and design wind speeds, mean return period, and wind pressure and force coefficients.
CO5	**Apply** the principles of boundary layer wind tunnel testing and structural dynamics for wind engineering problems.
CO6	**Demonstrate** estimation of wind pressures/loads on a low-rise building and evaluation of along-wind base moment of a tall building using IS Code provisions.

Course Content:

Unit 1: Short and long term statistics of wind, wind mechanics; effect of wind on tall structures; buildings, chimneys; Towers etc.

Unit 2: Wind effect on bridges, wind tunnel testing; Statistical analysis of wind;

Different codes of practices related to wind; Field studies on wind Engineering, case studies. **Unit 3:** Application of relevant IS codes to practical design

Unit 4: Wind gust loading:- Basic concepts, spectral description structural response of the line-like structure,

Unit 5: Aerodynamics damping Aerodynamics instability: Vortex shedding, Along wind and ovalling excitation - design impact and counter measures, Aeroelastic excitation: galloping - flutter.

Unit 6: Design Wind speeds and risk coefficients, Design wind pressure and pressure coefficients, Vortex shedding, gust factors. Approximate methods.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-3
Test-2	25 Marks	Based on Unit-3 and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Test/Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lectures notes, Tutorials, slides (will be added from time to time), Digital copy will be available on the JUET server.

Reference Books:

[1] Holmes J.D., Wind Loading of Structures, 2001, Spon Press, New York.
[2] Dyrbye,C. and Hansen,S.O., Wind loads on structures, John Wiley & Sons, 1996.
[3] Simiu E. and Scanlan RH. Wind effects on structures, 3rd ed., 1996; Wiley-Interscience, New York.
[4] Taranath, B.S., Reinforced concrete design of tall buildings, First Indian Reprint 2011,Taylor and Francis Group, New York.

[5] Cook,N.J., (1985) The Designer’s Guide to wind loadings of buildings and structures, Parts 1 and 2., Butterworth Publishers, London.

Course Description

Title of the course: Blast Resistant Design of Structures **Course Code:CE722**
L-T-P Scheme: 3-0-0 **Course Credits: 3**

Prerequisites: Design of Concrete Structure, Design of Steel Structures

Objective: To provide an insight to the students regarding the fundamentals of designing structures subjected to blast loading.

Learning Outcomes:

CO1	**Outline**the different types of explosions and the dynamics of materials.
CO2	**Identify**the blast loads on structures.
CO3	**Analyze**the response of structures to blast loads.
CO4	**Describe**the parameters affecting the design and analysis of structures subjected to blast loading.
CO5	**Demonstrate**the ability to design and analyze concrete structural elements subjected to blast loading.
CO6	**Explain**the concept of progressive collapse and window design philosophy.

Course Content:

Unit 1: Introduction to explosion effects: Air-blast, Fragmentation, Stand-off distance vs. Explosive charge mass, Chemical explosives Classification, initiation, TNT-equivalence, blast wave parameters calculation Types of industrial explosions and loads: TNO method, Baker-Strehlow Tang method, equivalent TNT method.

Unit 2: Blastload-structure interaction Contact / Near contact, close-in and far-field loading, Front face loading, blast clearing, stagnation pressure, Side wall and roof loading, Back face loading, Net loading on structure, Ground Shock Material Response to High strain Rate loading.

Unit 3: Dynamic behaviour of materials, Stress wave propagation, Reflection and Transmission of Stress waves, X-T Diagrams, Plastic Stress waves, Charpy Impact Test, Instrumented Drop Test, Split-Hopkinson Bar Test, Taylor Impact Test, Flyer Plate Test, Johnson Cook Material Constitutive Model.

Unit 4: Single-degree-of-freedom analysis of structures: D'Alambert's principle, dynamic equation of motion, free and forced vibration, harmonic forced vibration, forced vibration to generalized loading, Duhamel integral, response to triangular loading (blast load). Equivalent SDOF analysis of structural elements and nonlinear systems, pressure-impulse diagrams for elastic system and elasto-plastic systems.

Unit 5: Design/analysis of reinforced concrete elements subjected to blast loading: Concrete and steel reinforcement behaviour under high strain rates (DIF), Response limits. Design for Progressive Collapse: Code provisions for structural stability, Alternate path method, Redundancy requirements.

Unit 6: Blast Resistant Window Design: Introduction to glass design standards for blast (DoD, GSA, VA), analysis and Design of windows, frames and Mullions.

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on the Blast Resistant Design of Structures (will be added from time to time): Digital copy will be available on the JUET server.

Books and references:
1. J.M.Biggs, Introduction to Structural Dynamics, McGrawHill, 1964
2. G.F. Kinney & K.J.Graham, Explosive Shocks In Air, 2nd Ed., Springer Science+Business Media New York, 1985

3. P.D.Smith, J.G.Hetherington, Blast and Ballistic Loading of Structures, Butterwoth &Heinemann, Elsevier,2003, ISBN 0-7506-2024-2
4. Design of Blast Resistant Buildings in Petrochemical Facilities, 2nd Ed., ASCE Publication,2010.
5. IS 4991 (1968): Criteria for blast resistant design of structures for explosions above ground.
6. UFC 3-340-02: Structures To Resist The Effects Of Accidental Explosions , December 2008Change 2, 1 September 2014
7. NAVFAC, Blast Resistant Structures, DESIGN MANUAL 2.08, DECEMBER 1986 8. General Services Administration (GSA), Alternate Path Analysis & Design Guidelines ForProgressive Collapse Resistance, 2013.

Course Description

Title: Computer Applications in Structural Analysis and Design Course CODE CE723
L-T Scheme: 3-0-0 Course Credits: 3

Prerequisites: None

Objective: To develop skills related to computer applications for the analysis and design of structures.

Learning Outcome:
At the end of the course, the student will be able to use specific software for the analysis and design of structures and obtain satisfactory the results.

Course Outcome	Description
CO1	**Outline** the engineering design principles
CO2	**Describe** the system and software requirements to carry out various structural analysis.
CO3	**Analyze** different design softwares
CO4	**Apply** the object oriented program design.
CO5	**Develop** software quality assurance plan.
CO6	**Design** different types of structures using different softwares such as STAAD PRO, ATENA, ADINA, ANSYS, DIANA

Course Content:

Unit-1: Engineering design principles

Unit-2: System and Software Requirements Analysis

Unit-3: Design and Implementation of Software

Unit-4: Object oriented design

Unit-5: Software Quality Assurance, Application Software in Civil Engineering STAAD PRO, ATENA, ADINA, ANSYS, DIANA

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.

- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Text Books / References:

1. Computer Aided Optimum Design Of Structures By: C. A. Brebbia, S. Hernandez, A.J. Kassab
2. Computer Analysis & Reinforced Concrete Design Of Beams By Fady R. S. Rostom

Course Description

Title: Masonry Structures **Code:** CE724

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:
Objective:
Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the properties of the constituents in masonry
CO2	**Identify the loads and stresses in masonry structures.**
CO3	**Analyze** the structural behaviour of masonry structure applied with various loads.
CO4	**Describe** the behavior of masonry buildings and their importance
CO5	**Enumerate** various design procedures and their significance in masonry buildings.
CO6	**Design** and seismic evaluation of masonry buildings.

Course Content:

Unit-1

Properties of constituents: units - burnt clay, concrete blocks, mortar, grout, reinforcement; Masonry bonds and properties: patterns, shrinkage

Unit-2

differential movement, masonry properties - compression strength; Stresses in masonry walls: vertical loads, vertical loads and moments - eccentricity & kern distance,

Unit-3:

lateral loads - in-plane, out-of-plane; Behaviour of masonry walls and piers: axial and flexure, axial-shear and flexure,

Unit-4

The behaviour of Masonry Buildings: unreinforced masonry buildings - the importance of bands and corner & vertical reinforcement, reinforced masonry buildings - cyclic loading & ductility of masonry walls;

Unit-5

The behaviour of masonry infill is in RC frames: strut action; Structural design of masonry in buildings: methods of design – WSD, USD, seismic design - seismic loads, code provisions, infills, connectors, ties;

Unit-6:

Seismic evaluation and strengthening of masonry buildings: methods - in-situ, non-destructive testing; Construction practices, and new materials.

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Masonry Structures (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Manual On Maintenance Engineering: Repair And Maintenance Of Civil Works And Structures By B.S, Nayak (2003)
2. Design of Masonry Structures by A.W. Hendry, B.P. Sinha, S.R. Davies CRC Press, 02-Sep-2003

Reference Books/Material:

1. Simplified Design of Masonry Structures by James Ambrose
2. Masonry Structural Design by Richard Klingner

Course Description

Title: Design of Substructures **Code: CE725**
T-P scheme: 3-0-0 **Credits: 3**
Prerequisite:

Objective:

To understand the effect of dynamic loads, stress condition under earthquake on soil and to assess the liquefaction potential of soil to design of block and reciprocation machine foundation as per design guidelines.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** design of efficient foundation system like strap, raft and pile foundation.
CO2	**Identify** the footings subjected to eccentric loading, uplift and overturning.
CO3	**Analyze** the geotechnical design considerations, Site and soil conditions, Soil liquefaction, Evaluating the liquefaction potential.
CO4	**Describe** the liquefaction of clayey soil, mitigation of liquefaction hazard by site modification, mitigation of liquefaction hazard by structural design.
CO5	**Determine** the seismic settlement, subsidence and differential compaction.
CO6	**Apply** the fault rupture, lateral seismic earth pressures.

Course Content:

Unit-1

Introduction to shallow, mat and deep footings, Design of strap, Raft and combined footings, Design of pile footings, caps for piles.

Unit-2

Design of different components of well foundations, Footings subjected to eccentric loading, uplift and overturning, Soil-Structure interaction, Sub grade reaction method

Unit-3

Geotechnical design considerations, Site and soil conditions, Soil liquefaction, Evaluating the liquefaction potential by Standard Penetration Tests, by Cone Penetration Tests.

Unit-4

Liquefaction of clayey soil, mitigation of liquefaction hazard by site modification, mitigation of liquefaction hazard by structural design.

Unit-5

Seismic Settlement, Subsidence and Differential Compaction, Fault Rupture, Lateral Seismic Earth Pressures. Case Studies.

Teaching Methodology:

- At the start of course, the course delivery pattern, importance of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lecture slides and study materials on design of substructures (will be added from time to time): Digital copy will be available on the JUET server.

TEXT BOOKS / REFERENCES:

1. Analysis And Design Of Substructures Limit State Design by Saran, Swami (2006)
2. Analysis And Design Of Substructures, 2/E (Google eBook) by Saran Oxford and IBH Publishing, 01-Jan-2006.
3. Analysis and Design of Substructures: Limit State Design 2nd Edition by Swami Saran Publisher: Oxford & IBH Publishing Co. Pvt Ltd.

Course Description

Title: Bridge Engineering **Code:** CE726

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite:

Objective:
Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the components and classification of bridges.
CO2	**Identify** and Discuss the IRC standard live loads and design the deck slab type bridges
CO3	**Analyze** the box culverts for the given loading and detail the box culverts
CO4	**Describe** and Design procedures for different bridges.
CO5	**Enumerate** various types of Bearing and Joints
CO6	**Design** and check the stability of piers and abutments

Course Content:

Unit-1

Definition, components of a bridge, classifications, the importance of the bridge. Investigation of Bridges: the need for investigations, selection of bridge site, preliminary data to be collected

Unit-2

design discharge and its determination, linear waterway, economical span, vertical clearance above HFL, scour depth, choice of bridge type

Unit-3:

Standard Specifications: for road bridges, I.R.C. loadings, code provisions on the width of the carriageway, clearances, loads considered, etc

Unit-4

standard specifications for railway bridges, Railway bridge code. Reinforced Concrete Bridges: T-beam bridge, Courbon's theory for load distribution, balanced cantilever bridges.

Unit-5

illustrative examples, pre-stressed concrete bridges, Slab Bridges. Sub Structure: Types of piers and abutments, design forces, design of piers, and abutments.

Unit-6:

Bearing and Joints: Various types of expansion bearing and fixed bearings, elastomeric bearings, joints, and types. Introduction to construction, inspection, and maintenance of bridges.

Teaching Methodology:

- At the start of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP, etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignments during the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carry marks.
- There will be assignments and quizzes at regular intervals. Students can build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4, Unit-5, and Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Bridge Engineering (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Bridge Engineering by S, Ponnuswamy (1999,2012)
2. Design Of Bridge Structures by Jagadeesh, T.R.
3. Essentials Of Bridge Engineering by D.Johnson, Victor (2012)

Reference Books/Material:

1. Design Of Modern Steel Railway Bridges by John F. Unsworth (2010)
2. Standard Specifications And Code Of Practice For Road Bridges Section V Steel Road Bridges (Limit State Method) by Indian Roads Congress (2010

Course Description

Title: Nanotechnology and Concrete **Code: CE727**
L-T-P Scheme: 3-0-0 **Credits: 3**

Prerequisites: Engineering Materials

Objective: To learn the fundamental concepts of Nano materials, Nano Technology and the basic concepts in concrete as well. At the end of course student can learn about the Nano technology concepts and advancements in concrete technology in a systematic way.

Learning Outcomes:

Course Outcome	Description
CO1	**Outline** the various ingredients used for making concrete, quality of materials, basic properties of concrete
CO2	**Describe** the fundamentals of High performance concrete and high strength concrete , white tapping, self compacting concrete
CO3	**Develop** various Nanostructure materials, Nano technology concepts
CO4	**Identify** various challenges faced in Nanotechnology applications in field, and also in testing of Nano materials
CO5	**Apply** the principles of durability of concrete, and the usage of Nano technology and Nano materials in Concrete structures
CO6	**Demonstrate** the concepts of Sustainable development, green materials, concrete infrastructure development by using green materials as per codal provisions**.**

Course Content:

Unit-1: The ingredients of concrete, quality of materials, basic properties of Concrete, Testing methods of concrete

Unit- 2: High performance concrete and high strength concrete , white tapping, self compacting concrete, Micro silica, dense packing system by using Nano materials,

Unit- 3: Nanostructure materials, Nano technology concepts, controlled permeability formwork
Unit- 4: Challenges in Nanotechnology, testing of Nano materials, latest developments of Nano materials, handling and storage of Nano materials, effects of storage at longer durations

Unit- 5: Possible performance and fabrication techniques, Durability requirements of concrete, creep of concrete, usage of Nano technology and Nano materials in Concrete structures
Unit-6: Sustainable development, green materials, concrete infrastructure development as per new codes**.** Storage of Nano materials at site.

Teaching Methodology:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lecture may be conducted with the aid of multi-media projector, white board, OHP etc.
- Attendance is compulsory in lectures which carries marks.
- At regular intervals assignments will be given. Students should submit all assignments during given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carries marks.
- There will be assignments, quizzes at regular interval, where students have an opportunity to build an appreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 and Unit-2 syllabus
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Nano Technology and Concrete (will be added from time to time): Digital copy will be available on the JUET server.

Text Books

1.Concrete: Microstructure, Properties, And Materials P. Kumar Mehta, J. M. Monteiro
2. Properties Of Concrete, A.M. Neville, Pearson Publications. New Delhi.
3. Nanotechnology of Concrete: Recent Developments And Future Perspectives Konstantin Sobolev, Surendra P. Shah, ACI Committee 236,
4. Nanotechnology Fundamentals And Applications By Karkare.

Reference books:

1.Springer Handbook Of Nanotechnology By Bharat Bhushan
2.Nanotechnology In Construction Peter Bartos, Royal Societ
3.Advanced Nanotechnology By Shiv Kant Prasad
4.Handbook Of Nanostructured Materials Andnanotechnology Vol. 4 By Hari. Singh, Nalwa(Editor) (2000)
5. Nanotechnology: A Gentle Introduction To The Next Big Idea By Mark,Ratner (2003)
6.Nanotechnology: Fundamentals And Applications By Manasi, Karkare (2008)

Course Description

Title of the course: Design of Fiber Reinforced Composite Structures Course Code: CE728

L-T-P Scheme: 3-0-0 **Credits: 3**

Prerequisites: Nil

Objective: To introduce the fundamental design concepts of Fiber Reinforced Composite Structures

Learning Outcomes:

CO1	**Outlinethe** basic design principles of fiber reinforced composite structures
CO2	**Identify**Various techniques for the manufacture of composite materials and their types.
CO3	**Analyze**the strength gain, deflection and failure of fiber reinforced composite structures.
CO4	**Describe**thetheories of failures of lamina and laminates.
CO5	**Demonstrate**the ability to select laminate design.
CO6	**Explain** the mathematical models developed for buckling of laminates.

Course Content:

Unit-1: Definition and classification of composite materials: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon-Carbon Composites. Reinforcements and Matrix Materials.

Unit-2: Layup and curing, fabricating process, open and closed mould process, Hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

Unit-3: Powder metallurgy technique, liquid metallurgy technique,special fabrication techniques.

Unit-4: Tensile and Compressive strength of Unidirectional Fiber Composites. Fracture Modes in Composites; Single and Multiple Fracture, Debonding, Fiber Pullout and Delamination Fracture. Strength of an Orthotropic Lamina; Maximum Stress Theory, Maximum Strain Criterion, Tsai-Hill Criterion, Tsi -Wu tensor theory. Comparison of Failure Theories.

Unit-5: Special cases of Laminates; Symmetric Laminates, Cross-ply laminates, Angle ply Laminates, antisymmetric Laminates, Balanced Laminate. Failure Criterion for a Laminate.Design of a Laminated Composite. Numerical Problems.

Unit-6: Laminate Strength Analysis, Deflection and Buckling of Laminates, Selection of Laminate Designs, Application of Laminate Analysis to Composite Structures

Teaching Methodology:

- At the start, of course, the course delivery pattern, prerequisite of the subject will bediscussed.
- The lecture may be conducted with the aid of a multi-media projector, whiteboard, OHP,etc.
- Attendance is compulsory in lectures that carry marks.
- At regular intervals, assignments will be given. Students should submit all assignmentsduring the given period.
- Classroom participation and involvement in solving the problems in Tutorial rooms carrymarks.
- There will be assignments and quizzes at regular intervals. Students can build anappreciation for the concept being taught in lectures.
- There will be three exams as per the evaluation scheme.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1,
Test-2	25 Marks	Based on Unit-2, Unit-3, and Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6,around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on the Design of Fiber Reinforced Composite Structures (will be addedfrom time to time): Digital copy will be available on the JUET server.

Books and references:

1. An Introduction to Composite Materials, by D. Hull and T.W. Clyne

2. Principles of Composite Material Mechanics by Ronald Gibson, CRC press, 2015, ISBN: 978-1-4987-8824-3
3. Composite Material Science and Engineering, Krishan K. Chawla, Springer, 3e, 2012
4. Robert M. Jones, Mechanics of Composite Materials, Taylor & Francis, 1999.
5. Introduction to Composite Materials Design, 2nd Ed. By Ever J. Barbero, CRC press, 2014,SBN:978-1-4398-9413-2