SEMESTER I

CE 50009 : ADVANCE CONCRETE TECHNOLOGY AND COMPOSITES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	2	-	3	1	-	30	70	40	60	200

COURSE OBJECTIVES:

1) Explain the characterization of constituents of concrete.
2) Design concrete mix by various methods as per different codes.
3) Explain the different types of admixtures, mix design, properties and applications of special concretes.

COURSE OUTCOMES: The students will be able to

1) Define hydration of cement and tests on properties of cement and aggregates.
2) Compare the properties and testing of concrete in fresh and hardened state.
3) Illustrate the shrinkage and creep mechanisms, curing and durability of concrete.
4) Design concrete mixes by various methods.
5) Explain the types of admixtures, and applications of special concretes.

Theory Content :

Unit - 1.

Cement: Types of cement and their composition - Manufacture of Portland cement - Hydration of cement and hydration product - Structure of hydrated cement - Heat of hydration - Gel theories - Review of tests on properties of cement.

Aggregate: Classification of aggregates - Particle shape and texture - Bond and strength of aggregate and its influence on strength of concrete - Porosity - Absorption and moisture content and their influence - Soundness of aggregate - Alkali aggregate reaction - Sieve analysis and grading of aggregate - Review of tests on properties of aggregate.

Unit - 2.

Properties of Concrete: Mixing and batching - Workability - Factors affecting workability –

Measurements of workability - Various tests and procedures - Segregation and bleeding - Vibration of concrete - Types of vibrators and their influence on composition - Analysis of fresh concrete - Strength of concrete - Water-cement ratio - Gel space ratio -

Effective water in the mix - Mechanical properties of concrete - Tests and procedure - Influence of various parameters on strength of concrete - Relationship between various mechanical strengths of concrete. Curing of Concrete: Methods of curing,

Unit - 3

Shrinkage and creep of concrete: Types of shrinkage - Mechanism of shrinkage - Factors affecting shrinkage - Creep mechanism - Factors influencing creep - Effects of creep. Rheology of concrete, Modulus of Elasticity, Maturity concept - Influence of temperature on strength of concrete. Durability of Concrete: Permeability of concrete - Chemical attack on concrete - Tests on sulphate resistance - Effect of frost - Concreting in cold weather - Hot weather concreting, Concreting underwater, hot & cold weather condition, statistical quality control, field control, Non Destructive Testing of Concrete. Introduction, Surface Hardness, Ultrasonic, Penetration resistance, Pull-out test, chemical testing for chloride and carbonation- core cutting - measuring reinforcement cover

Unit – 4

Admixtures: Classification of admixtures - Chemical and mineral admixtures - Influence of various admixtures on properties of concrete and their applications. Application of admixture in repair and construction of concrete. Classification and use of Fly ash..

Special Concretes: Study of Various types of Concrete such as: Light weight Concrete, Heavy Weight concrete, Ready mix concrete, Vacuum concrete, Fiber reinforced concrete, Polymer concrete, composites, Shotcrete, Guniting, Sulphur Resistance concrete, Self-Compacting Concrete, High Volume Fly Ash Concrete, High Performance Concrete, Heat resistant concrete, Mass concrete, High Performance

Unit -5

Design of Concrete Mix : Basic considerations ,Process of mix design for various types of concrete, Factors in the choice of mix proportions and their influence, Quality control, acceptance criteria for concrete, Various methods of mix design - IS code method ,IRC method, British and ACI methods, computer aided design of concrete mix.

Books & References Recommended:

- *Concrete Technology* by Varshney RS;; Oxfored & IBH Publishing Co.
- *Concrete Technology* by MS Shetty , SChand Pulication
- *Concrete Technology* by Gambhir ML,TMH
- *Concrete Technology by A.R. Santha kumar, Oxford University Press Oct 2006.*
- *Properties of Concrete* - A.M. Neville - Pearson Education
- *Advances in Building Materials & Construction* by Mohan Rai & M.P. Jai Singh;

- *Advanced Concrete Technology* – Zong Jin Li , JOHN WILEY & SONS, INC.
- *Hand books on Materials & Technology* - Published by BMTPC & HUDCO
- *IS: 10262 - 2019* Concrete Mix Proportioning — Guidelines **(Second Revision)**

Books & References Recommended:

1) A.M. Neville, “Properties of Concrete”, English Language Book Society-Longman Publications, 1988.
2) P.K. Mehta and J.M.M. Paulo, “Concrete – Microstructure – Properties and Material”, McGraw-Hill, New York, 1997.
3) Krishna Raju, “Design of Concrete Mix”, CBS Publications, New Delhi, 1985.
4) *Concrete Technology* by Varshney RS;; Oxfored & IBH Publishing Co.
5) *Concrete Technology* by MS Shetty , SChand Pulication
6) *Concrete Technology* by Gambhir ML,TMH
7) *Concrete Technology by A.R. Santha kumar, Oxford University Press Oct 2006.*
8) *Advances in Building Materials & Construction* by Mohan Rai & M.P. Jai Singh;
9) *Advanced Concrete Technology* – Zong Jin Li , JOHN WILEY & SONS, INC.
10) *Hand books on Materials & Technology* - Published by BMTPC & HUDCO
11) *IS: 10262 - 2019* Concrete Mix Proportioning — Guidelines **(Second Revision)**

CE 50015 : Advanced Soil Mechanics & Foundation Engineering

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	Tu.	T	P	Tu.	THEORY		PRACTICAL		TOTAL MARKS
3	2	-	3	1	-	CW	END SEM	SW	END SEM	200
						30	70	40	60	

COURSE OBJECTIVES:

1) To classify different types of foundation systems & Structures
2) To discuss and evaluate feasibility of foundation solution to different types of soil conditions considering the time effect on soil behaviour.
3) To build the necessary theoretical background for design, construction of foundation systems

COURSE OUTCOMES: The students will be able to

1) Illustrate systematic methods for designing foundation.
2) Evaluate feasibility of foundation solution to different types of soil conditions considering the time effect on soil behaviour.
3) Design of construction of foundation systems

Theory Content :

Unit-1 Sub Soil Exploration And Ground Improvement Techniques.

Method of Investigation, Reconnaissance and detail investigation program for different Civil Engineering Projects.

Different methods of Ground Improvement : Soil Stabilisation, Type and Methodology. Geosynthetics Reinforced Earth, Stone columns sand drains etc.

Unit-2 Shear Strength and Bearing capacity

Shear Strength : Mechanism Effective stress , State of Stress, Stress, Strain and Strain path failure theories, Skempton's Pore Pressure parameters, Hyorslev Shear Strength parameters, Sear strength characteristics of soil under undrainded and drained conditions, Shear behavuiour of dry and saturated soils, laboratory and field determination of shear parameters.

Stability of Slopes: Types of Slope Failure, Bishop's Slope Stability analysis, Stabilty number, Selection of shear parameters for analysis of geotechnical problems.

Bearing capacity: Skempton's analysis, Plate load test, Penetration tests, general bearing capacity equation and effect of water table on bearing capacity.

Unit-3 Earth Pressure

Classical theories, various types of backfill and evaluation of earth pressure, effect of submergence, Effect of surcharge and wall inclination, Condition for maximum active and passive earth pressure from sliding wedge, Rebnann's graphical construction for active passive earth pressure, Culman's graphical method.

Unit-4 Analysis and design of Foundations

Different types of shallow and deep foundations, Design of isolated, combined, strip footings and mat foundations based on shear and settlement criterion.

Different types of piles, load carrying capacity of different types of piles, group action of piles, negative skin friction, Design of pile and pile cap.

Well foundation : Types, sinking of well, Components, Forces acting and design of different components, Caisson, tilt and shift

Unit-5 Dynamic Soil Parameters and Machine Foundations

Dynamic shear parameters liquefaction, factors affecting liquefaction, Natural Frequency Damped and undamped, Cyclic Plate load test, Hammer test, Coefficient of uniform compression and its importance, Block Vibration test, Different modulus of Dynamics, Design of Machine foundations, IS 5249.

Books & References Recommended:

1. Foundation Analysis & Design by *J.E.Bowles*
2. Basic & Applied soil – Mechanics by *Gopal Ranjan & Rao*
3. Principles of Foundations Engg. by *Braj M.Das*
4. Principles of Geotechnical Engg. by *Braj M. Das*
5. Geotechnical Earthquake Engg. by *Ksans*
6. Soil Mechanics in Engg. Practice by *Terzaghi M. Rech*
7. Fundamentals of Soil mechanics by *Taylor*
8. IS 5249

CE 51008 : FINITE ELEMENTS METHOD

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Identify, formulate and solve engineering problems using matrix method.
2) Apply the techniques, skills, and modern engineering tools like flexibility & stiffness method necessary for engineering practice.
3) To Explain different steps and approaches to solve a problem using FE method.
4) To define the behaviour and uses of different types of elements.
5) To develop the solution in many points as much as we want of an object by discretizing the object.
6) Derive the element stiffness matrix for 1-D, 2-D and 3-D problems.
7) Formulate the simple structural problems into finite elements.
8) To solve for different real life engineering problem of any dimensions (1D, 2D and 3D).
9) To develop the use of computer to solve complex problem along with applied boundary conditions using FE method.

COURSE OUTCOMES: The students will be able to

1) Build and analyse the FEA models for various engineering problems.
2) Identify the information requirements and sources for analysis, design and evaluation.
3) Solve the structural engineering problems using the standard finite element.
4) Interpret the results obtained from FEA software, not only in terms of conclusions but also awareness of limitations.

Theory Content :

Unit – 1.

MATRIX METHOD OF ANALYSIS: FLEXIBILITY METHOD & STIFFNESS METHOD

FLEXIBILITY METHOD: Force methods. Basic concepts, evaluation of flexibility coefficients, flexibility transformations. Energy approach in Flexibility method. Effect of support displacement and transformation, Analysis of member of different types.

STIFFNESS METHOD: Displacement methods, Basic concepts, Evaluation of stiffness coefficients, Direct stiffness method. Energy approach in stiffness method. Effect of support displacement and temperature.
Applications of flexibility and stiffness methods to plane and space structures with pin joints and rigid joints.

Unit – 2.

INTRODUCTION TO FINITE ELEMENT METHOD : General Applicability and Description of Finite Element Method comparison with other Methods.

SOLUTION OF FINITE ELEMENT METHOD : Solution of Equilibrium Problems, Eigen value problems, propagation problems, computer implementation of Gaussian eliminations, Choleski's decomposition, Jacobi's and Ranga Kutta Method.

Unit – 3.

GENERAL PROCEDURE OF FINITE ELEMENT METHOD : Discretization of the domain, Selection of Shapes, types and number of elements, node numbering technique, Interpolation Polynomials, their selection and derivation in terms of global and local coordinates, Convergence requirements. Formulation of Element Characteristic matrices and vectors, Variational approach. Assembly of Element matrices and Vectors and Derivation system equations, computation of element resultants.

Unit – 4.

ISOPARAMETRIC FORMULATION : Lagrange and Hermite interpolation functions, Isoparametric Elements. Numerical Integration.

Unit – 5.

STATIC ANALYSIS : Formulation of equilibrium equations, Analysis of truss, Frames, Plane Stress and Plane Strain Problems Plates and Shells.

Books & References Recommended:

1) R.D. Cook, "Concepts and Application of Finite Element Analysis", John Wiley and Sons, 1981.
2) O.C. Zienkiewicz and R.L. Taylor, "The Finite Element Method, Volume 1: The Basis", McGraw-Hill, London, 1989.J.N. Reddy, "An Introduction to the Finite Element Method", McGraw-Hill, New York, 1993.
3) David V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill, New Delhi, 2005.
4) K.J. Bathe, "Finite Element Procedures", Prentice Hall of India, New Delhi, 2006.

5) T.R. Chandrupatla and A.D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall of India, New Delhi, 2001.
6) P. Seshu, “Finite Element Analysis”, Prentice Hall of India, New Delhi, 2003.

CE 51457 : COMPUTING TECHNIQUES LAB

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
0	2	-	0	2	-	0	0	40	60	100

COURSE OBJECTIVES:

1) Discuss Numerical examples with the help of worksheets & MATLAB
2) Explain Computer fundamentals
3) Discuss numerical using different numerical techniques
4) Illustrate the analysis and design structures using design software

COURSE OUTCOMES: Students will be able to

1) Solve Numerical examples with the help of worksheets & MATLAB
2) Explain Computer fundamentals
3) Solve numerical using different numerical techniques
4) Analyse and design structures using design software

Theory Content :

Unit – 1.

Computer Fundamentals : Computer Components, Hardware and Software, Different types of Input/Output units, Binary and Decimal Conversions.

Unit – 2.

Numerical Techniques

Unit – 3.

Numerical examples with the help of worksheets & MATLAB.

Unit – 4.

Introduction to Structural Analysis & Design Software.

Unit – 5.

Application of Structural Design and Analysis Software.

Books & References Recommended:

- 1) Balagurusamy E.,"Fundamentals of Computers" McGraw-Hill Inc.,US,2018
  2) Y.K. Singh,' Matlab Programming', Prentice Hall India Learning Private Limited (2007)

SEMESTER II

CE 51517 : ADVANCED CONCRETE STRUCTURES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1. To illustrate the basic design philosophies for the concrete structures.
2. To design the various concrete structures like flat slab, shells, folded plates.
3. To discuss the different design approaches for a particular structure.
4. To design and analyse various concrete structures using the codes.
5. To Explain the concept of Prestressed concrete.

COURSE OUTCOMES: The students will be able to

1. Explain and adopt the different methods for designing .
2. Design various concrete structures.
3. Apply proper codes for designing.
4. Make proper use of prestressed concrete.

Theory Content:

Unit - 1.

Design Philosophies: Introduction to various design philosophies, their merits and drawbacks, code provisions and their meaning. Inelastic Analysis of R.C. Beams & Frames, and confinement of RC member, Introduction to Prestressed concrete

Unit - 2

Grid Structures : Types of R.C. C. Grids, behaviour, design by approximate and exact methods.

Unit - 3

Flat Slab : Definition, Types, Behaviour, Direct Design Method, Equivalent Frame Method.

Unit - 4

Circular Cylindrical Shells: Behaviour, Design using ASCE Manual Method.

Unit - 5

Folded Plate : Types, Behaviour, Comparison with Shell, Analysis and Design using Whitney Method, Introduction to Simpson's Method.

Books & References Recommended:

1. Limit State method– by *A.K.Jain*
2. Reinforced Cement concrete by *Malik & Gupta*
3. Thin Concrete shells by *W.P.Bilington*
4. Prestressed Concrete by *Krishna Raju*
5. Advanced R.C.C. by *Vargheese*
6. Theory of Plates & Shell by *S.P. Timoshenko*

CE 51518 : ADVANCED METAL STRUCTURES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Explain the fundamentals of design of steel tanks and grillage foundations.
2) Solve the practical problems pertaining to steel tanks and grillage foundations.
3) Illustrate the concepts of analysis and design of various members of tubular structures.
4) Explain of the design of bunkers and silos using appropriate method and solve the practical problems pertaining to it.
5) Explain the fundamentals of design of transmission line towers and solve the practical problems pertaining to it.
6) Explain the concepts of analysis and design of various members of light- gauge steel structures.

COURSE OUTCOMES: The students will be able to

1) Design and detail the rectangular plated and pressed steel tanks.
2) Propose the grillage foundations for structures.
3) Design and detail the hollow rectangular, square and circular tubular members in a truss including its joints.
4) Formulate the rectangular and square bunkers and silos using appropriate method.
5) Propose the geometry and analyse and design the transmission towers subjected to various loads.
6) Design the light gauge steel compression and flexural members.

Theory Content :

Unit – 1.

Study and Interpretation of loading standards for buildings and bridges, Codal provisions for special structures. Design of High Rise framed buildings, Grillage foundations: Introduction - Necessity of grillage foundation - Various types - Grillage foundations for single and double columns. Tubular structures: Introduction - Permissible stresses - Design considerations - Design of tension members - Compression members and flexural members - Design of tubular trusses including joints.

Unit – 2.

Design of storage storage structures. Bunkers, Silos, Water tanks including design of staging and bracings.

Unit – 3.

Design of truss bridges, plate girder bridges, including design of bracings and bearings. chimneys, guyed towers, T.V. towers and Antenna structures. Transmission line towers: Classification - Economical spacing - Design loads - IS codal provisions - Calculation of wind loads - Permissible stresses - Overall arrangement and design procedure - Detailed design including foundations.

Unit – 4.

Introduction to design of space structures, Double layer grids, curved space frames, folded plates and suspended structures

Unit – 5.

Design of light gauge steel structures: Introduction - Forms of light-gauge sections - Behaviour of compression elements - Effective width for load and deflection calculation - Behaviour of unstiffened and stiffened elements - Design of compression members -
Design of Aluminium Structures.

Books & References Recommended:

1) S.K. Duggal, “Design of Steel Structure”, Tata McGraw-Hill, New Delhi, 2009.
2) B.C. Punmia, “Design of Steel Structures”, Laxmi Publications, New Delhi, 2001.
3) Ram Chandra, “Design of Steel Structures”, Vol. I & II, Standard Book House, New Delhi, 1989.
4) P. Dayaratnam, “Design of Steel Structures”, Orient Longman Publications, New Delhi, 1987.
5) I.C. Syal and S. Singh, “Design of Steel Structures”, Standard Book House, New Delhi, 2000.

CE 51519 : EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Explain the causes of earthquake and effects of ground motion and modeling of structures.
2) Illustrate the response spectra and structural dynamics of MDOF systems.
3) Discover the different analysis and design approaches like equivalent lateral force method and inelastic time history analysis.
4) To train in the ductile detailing of reinforced concrete structures as per IS 4326 and IS 13920.
5) Explain the seismic analysis of masonry buildings.

COURSE OUTCOMES: The students will be able to

1) Apply the concepts of structural dynamics of MDOF systems for analysis of structures.
2) Model and analyse the structures to resist earthquake forces by different methods.
3) Design the various structural elements resisting earthquake forces as per IS Codes.
4) Do ductile detailing of reinforced concrete and masonry buildings as per codal provisions.

Theory Content :

Unit – 1.

Earthquake Ground Motion: Engineering seismology - Seismic zoning map of India - Strong motion studies in India - Strong motion characteristics - Evaluation of seismic design parameters. Structural Dynamics: Initiation into structural dynamics - Dynamics of SDOF systems - Theory of seismic pickup - Numerical evaluation of dynamic response - Response spectra - Dynamics of MDOF systems.

Unit – 2.

Concepts of earthquake resistant design of RCC structures: Basic elements of earthquake resistant design - Identification of seismic damages in RCC buildings - Effect of structural irregularities on performance of RCC buildings during earthquakes - Earthquake resistant building architecture.

Unit – 3.

Seismic analysis and modeling of RCC structures: Code based procedure for determination of design lateral loads - Infill walls - Seismic analysis procedure as per IS 1893 code - Equivalent static force method - Response spectrum method - Time history analysis - Mathematical modeling of multi-storey RCC buildings.

Unit – 4.

Earthquake resistant design of RCC structures: Ductility considerations - Earthquake resistant design of multi-storey RCC buildings and shear walls based on IS 13920 code - Capacity based design.

Unit – 5.

Earthquake resistant design of masonry structures: Identification of damages and non-damages in masonry buildings - Elastic properties of structural masonry - Lateral load analysis of masonry buildings - Seismic analysis and design of one-storey and two-storey masonry buildings.

Books & References Recommended:

1) Bruce A Bolt, ""Earthquakes", W.H. Freeman and Company, New York, 2004.
2) C.A. Brebbia, "Earthquake Resistant Engineering Structures", WIT Press, 2011.
3) Mohiuddin Ali Khan, "Earthquake Resistant Structures: Design, Build and Retrofit", Elsevier Science & Technology, 2012.
4) Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, New Delhi, 2009.
5) T. Paulay and M.J.N. Priestley, "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and Sons, 1992.
6) S.K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, New Delhi, 2007.

ELECTIVE I

CE 51217 : ADVANCED STRUCTURAL ANALYSIS

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1. To Explain different approaches for analysis of indeterminate structures.
2. To Discuss different mathematical procedures and applications .
3. To discuss stiffness matrix approach.
4. To discuss flexibility matrix approach.
5. To explain the fundamental concepts of FEM.

COURSE OUTCOMES: The students will be able to

1. Apply knowledge of mathematics, science, and engineering to understand indeterminate structure determinate-indeterminate structures.
2. Identify, formulate and solve engineering problems using flexibility matrix method.
3. Apply the techniques, skills, and modern engineering tools like stiffness method necessary for engineering practice.

Theory Content

Unit - 1.

MATRIX METHOD (FLEXIBILITY METHOD): Force methods. Basic concepts, evaluation of flexibility coefficients, flexibility transformations. Analysis of a single member of different types. Transformation of single member.

Unit - 2.

Applications to plane and space structures with pin joints and rigid joints. Energy approach in flexibility method., Effect of support displacements and transformation.

Unit - 3.

MATRIX METHOD (STIFFNESS METHOD): Displacement methods, Basic concepts, Evaluation of stiffness coefficients, Direct stiffness method. Energy approach in stiffness method. Code No. approach for global stifness matrix. Effect of support displacement and temperature.

Unit – 4

Symmetrical & antisymmetrical problems. Stiffness of plane & space frames. Solution of problems. Comparison of force and displacement methods of solution.

Unit - 5

SPACE FRAME: Tension coefficient method for analysis of pin jointed structural frames. Applications and different types of space truss. Introduction to “Finite element method”

Books & References Recommended:

1) Ashok and K. Jain "Advanced Structural Analysis", New Channel Brothers, 2015.
2) Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
3) Asslam Kassimali, "Matrix Analysis of Structures", Brooks-Cole Publishing Co., USA, 1999.
4) Amin Ghali, Adam M. Neville and Tom G. Brown,"Structural Analysis - A Unified Classical and Matrix Approach", Sixth Edition, Chapman & Hall, 2007.
5) James M. Gere and William Weaver, "Matrix Analysis of Framed Structures", CBS Publishers & Distributors, Delhi, 2012.
6) C. K. Wang, "Matrix Methods of Structural Analysis", Mc Graw Hill Book Company, New Delhi, 1983.
7) N. Krishna Raju and D.R. Gururaja, "Advanced Mechanics of Solids and Structures", Narosa Publishing House, New Delhi, 1988.
8) Seely and Smith, "Advanced Mechanics of Materials", New York, 1955.
9) Basic Structural Analysis by *C.S.Reddy – (TMH Publisher)*
10) Matrix Analysis of Framed Structures by *William Wearer Jr. & James M.Gere (CBS Publisher)*

CE 51212 : STRUCTURAL DYNAMICS

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Discuss the various types as well as characteristics of loading and formulate the equations of motion.
2) Explain the response of un-damped and damped SDOF and MDOF systems under various loadings.
3) Apply the approximate and iterative methods to model continuous vibratory systems.
4) Use the seismic codes in analysis and design of civil engineering structures.
5) Illustrate the dynamic response by numerical methods.

COURSE OUTCOMES: The students will be able to

1) Explain the fundamental theory of dynamic equation of motions and analysis methods for dynamic systems.
2) Illustrate the modelling approach of dynamic response in civil engineering applications.
3) Create the simple computer models for engineering structures using knowledge of structural dynamics.
4) Evaluate the dynamic response analysis results and understand the possible error sources.
5) Interpret the dynamic analysis results for design, analysis and research purposes.
6) Apply the structural dynamics theory to earthquake analysis, response, and design of structures.

Theory Content :

Unit – 1.

Single Degree of Freedom System : Free and forced vibrations, Linear Viscous Damper, Coulomb Damper : Response to harmonic excitation, rotating unbalance and support excitation. Vibration isolation and transmissibility. Single degree of freedom system as vibrometer and accelerometer. Response to periodic and arbitrary excitation.

Unit – 2.

Duhamel's integral. Impuse response function. Laplace transform Fourier transform methods. Frequency response function. Phase-Plane Techniques. Critical speed of roters. Energy methods, Rayleigh's method, Equivalent viscous dampling.

Unit – 3.

Two Degree of Freedom System. Matrix Formulation, Free Vibration, Beat pnenomenon. Principle of damped and undamped vibration absorbers.

Unit – 4.

Multi-Degree of Freedom Systems : Matrix formulation, stiffness and flexibility influence coefficients. Eigenvalue problem. Normal modes and their properties. Matrix iteration technique for eigen values, and eigen vectors. Free and forced vibration by modal analysis.

Unit – 5.

Continous System : Axial vibration of bar, torsional vibration of shafts, transverse vibration of strings and bending vibration beams. Forced vibration. Normal mode method. Lagrangle's equation. Approximate methods of Rayleigh-Ritz, Galerkin etc.

Books & References Recommended:

1) Walter C. Hurty and Moshe F. Rubinstein, "Dynamics of Structures", Prentice Hall, New York, 1964.
2) Clough, W. Ray, and Penzien, Joseph, "Dynamics of Structures", McGraw-Hill, New York, 1982.
3) Mario Paz, "Structural Dynamics", CBS Publishers, New Delhi, 1987.
4) A.K. Chopra, "Dynamics of Structures", Prentice Hall India, New Delhi, 1996.

CE 51213 : STABILITY OF STRUCTURES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Discuss the buckling of columns, analysis using equilibrium, energy and approximate methods.
2) Explain the stability analysis of beam-columns and frames with different loads.
3) Analyse for torsional, flexural and lateral buckling of beams.
4) Perform the buckling analysis of thin plates using different approaches.
5) Discuss the inelastic buckling analysis of plates.

COURSE OUTCOMES: The students will be able to

1) Explain the analysis of buckling of columns using appropriate method.
2) Analyse the practical problems of beam-columns and frames.
3) Analyse the beams for torsional, flexural and lateral buckling.
4) Perform buckling analysis of thin plates.
5) Analyse the plates for inelastic buckling and understand the post- buckling behaviour of plates.

Theory Content :

Unit – 1.

Concepts of Stability, Euler Buckling Load, Critical Load of Laced, Battened and Tappred columns, Inelastic Buckling of column.

Unit – 2.

Torsional and lateral buckling: Torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of open sections - Numerical solutions - Lateral buckling of beams - Pure bending of simply supported beam and cantilever beam.

Unit – 3.

Lateral Instability of Beams.
Beam Columns.

Unit – 4.

Buckling of plates: Governing differential equation - Buckling of thin plates - Various edge conditions - Analysis by equilibrium and energy approaches - Approximate and Numerical techniques. Inelastic buckling: Double modulus theory - Tangent modulus theory - Shanley's model – Eccentrically loaded inelastic column - Inelastic buckling of plates - Post buckling behaviour of plates.

Unit – 5

Application of Energy method and matrix method in stability problems.

Books & References Recommended:

1) S. Timoshenko and Gere, "Theory of Elastic Stability", McGraw- Hill, New York, 1963.
2) A. Chajes ,""Principles of Structures Stability Theory", Prentice Hall, New York, 1974.
3) Ashwini Kumar, "Stability Theory of Structures", Tata McGraw- Hill, New Delhi, 1995.
4) N.G.R. Iyenger, "Structural Stability of Columns and Plates", Affiliated East West Press, New Delhi, 1986.
5) M.L. Gambhir, "Stability Analysis and Design of Structures", Springer, New York, 2004.

CE 51214 : THEORY OF ELASTICITY & PLASTICITY

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) To discuss theoretical fundamentals of theory of elasticity and plasticity.
2) To apply the principles of the theory of elasticity and plasticity in engineering problems.
3) To analyze the basic elasto-plastic problems associated with different processes practiced in the present day industries.
4) Explain the concepts of elasticity and equip them with the knowledge to independently handle the problems of elasticity.
5) Enhance the competency level and develop the self-confidence through quality assignments in theory of elasticity.
6) Develop the habit of researching and practicing in the field of elasticity.

COURSE OUTCOMES: The students will be able

1) To Explain the basic concepts of fundamental variables such as stress, strain, and displacement under the application of load and equations of equilibrium and compatibility.
2) To solve the basic problems of the theory of elasticity by using stress function.
3) To discuss typical plastic yield criteria established in constitutive modelling.
4) To apply analytical techniques to predict stress, strain and deformations under given applied loads.
5) To apply the principles of plasticity to analyze the industrial processes such as auto-frettage, rolling, extrusion etc.
6) To Explain the principles of new autofrettage techniques such as thermal autofrettage.
7) To Interpret various theories of torsion of prismatic bars of various cross sections and solve the problems of torsion.
8) To Interpret and apply the theory of elasticity to practical problems of structural engineering.

Theory Content :

Unit - 1.

Theory of Elasticity : Elastic behaviour of engineering materials, Stress and strain. Components of stress and strain in three dimensional structural model. Generalised Hooke's law. Elastic constants.Plane stress and plane strain problems in elasticity. Principal stresses

and principal strains. Compatibility of stress and strain. Equilibrium equations and compatibility equations, Boundary conditions. Stress function. End effects, Saint Venant's principle, solution of problems by polynomials. Determination of displacements. Solutions of simple problems of flexure of two dimensional structures. Solution of problems in form of Fourier series.

Unit - 2.

General equations in polar coordinates, stress distribution symmetrical about axis, curved beams and cylinders, Strain components in polar coordinate. Stresses in circular disc. Concentrated loads and couples on structures and surfaces. Differential equations of equilibrium and conditions of compatibility in three dimensional stress field. principles of superposition, strain energy theorems, Castigliano's theorems. principle of virtual work. Uniqueness of solutions.

Unit - 3.

Concept of Beam columns, Differential equations for beam-columns. Beam columns with concentrated lateral loads and continuous lateral loads with different edge conditions. Application of trigonometric series for solution. Elastic Buckling of bars and frames, Euler's column formula. critical loads, Use of theory of beam column for critical load calculation. Buckling of bars and frames for simple loading.

Unit - 4.

Theory of Plasticity: Basic experiments of monotonic loading tension and compression tests, Loading-Unloading reloading types, Loading-Unloading Reverse Loading type, their Observations, Definitions of Nominal Stress, Strain, True Stress, Natural strain etc. and their relations. Bauschinger's effects, Strain hardening, Stress-strain Curves, their empirical equations.

Stress and strain Tensors, principal stresses and strains, stress and stain invariants, maximum and octahedral shear stresses and strains, stress and strain deviator tensor.

Unit – 5.

Definitions of yield criteria on II-plane, C-Curve etc. carious yield criteria like Rankines, Saint-Venant's, Trescas and von mises and their 2 Dimensional representation.

Subsequent Yield Surfaces, Isotropic and Kinematic hardening, Plastc work, Prandtl- Renss Equations Plastic stress strain relations.

Books & References Recommended:

1) S. Timoshenko and N. Goodier, "Theory of Elasticity", McGraw- Hill, New York, 1951.
2) Valiappan, "Theory of Elasticity", McGraw Hill, New Delhi, 1974.
3) Sadhu Singh,, "Theory of Elasticity", Khanna Publishers, New Delhi, 1988. Timoshenko and Goadies, "*Theory of Elasticity*".
4) C.R.Calladine, "*Engineering Plasticity*" Pergamoa press 1969.
5) Amendelsoa, "*Plasticity Theory and Application*" Macmillen 1968
6) Lubliner, "*Plasticity Theory*"
7) Chakraborti P.K. "*Plasticity"* TMH

CE 51215 : INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

To discuss the principles of measurements of static and dynamic response of structures and carryout the analysis of results.

COURSE OUTCOMES: The students will be able to

1) Measure strain.
2) Measure effects from vibration and wind blow.
3) Analyze the structure by non-destructive testing methods and model analysis.

Theory Content :

Unit – 1.

Generalized measurement systems, calibration and sensitivity. Standards of measurements of various quantities.

Detectors : Sensor system elements, transducer and devices, Different types of sensors, Modifying and transmitting method. Mechanical, Hydraulic, Electrical and Electronic System.

Unit – 2.

Construction details of : Temperature transducers, vibration and shock measurement. Vibration pick-ups, Force and Load transducers, Velocity transducers, Torque transducers, Pressure measurements and pressure transducers.

Unit – 3.

Photo elasticity : Basic optics and polariscope Photo elastic effect: Stress-optic relations, Isoclinics. Isochromatics, Calibration of model, Separation techniques. Fractional Fringe order determination, Analysis of photoelastic data. Introduction to 3D Photoelasticity, Stress Freezing techniques, Slicing Tech. And Scattered light photo elasticity.

Unit – 4.

Moiré Fringe Technique: Moiré phenomenon, Analysis of Moiré fringes. Measurement of strain, displacement, rotations and slope for in plane and out of plane problems.

Unit – 5.

Model Analysis : Different types of model, Laws of structural similitude and non-dimensional analysis, Buckingham Pi theorem, Predictions for prototype, size effect, Applications. Accuracy and reliability of structured models.

Books & References Recommended:

1. Dalley .J.W and Riley.W.F, “Experimental Stress Analysis”, McGraw Hill Book Company, N.Y. 1991
2. Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.
3. Ravisankar.K.and Chellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures”, SERC, Chennai, 2007.
4. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.
5. Sirohi.R.S., Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997.

CE 51216 : Quality and safety in Construction

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1. To explain the concept of QC (quality control), quality assurance (QA) and TQM (total quality management).
2. To illustrate the concept of the international quality standard ISO 9001.
3. To discuss the measurement quality costs of construction processes.
4. To understand the importance of safety management in construction and the reduction of accidents on construction sites.

COURSE OUTCOMES: The students will be able to

1. To explain the concept of QC (quality control), quality assurance (QA) and TQM (total quality management).
2. To define the concept of the international quality standard ISO 9001.
3. To measure quality costs of construction processes.
4. To illustrate the importance of safety management in construction and the reduction of accidents on construction sites.
5. To apply safety management systems for construction firms and their sites. 6. To understand the relationship between safety investment and the financial, social and pain & suffering costs of construction accidents

Theory Content :

Unit –1

Concept of Quality: Definition of quality as given by Deming, Juran, Crosby, difference between Quality control, Quality Assurance (QA/QC). Total quality control (TQC) and Total Quality Management (TQM), Need for TQM in construction industry. Organization necessary for implementation of quality, Quality manual-Contents, data required, preparation, responsibility matrix, monitoring for quality- PDCA Cycle. Quality aspects in every phase in the life cycle of Construction project.

Quality Control tools and statistical quality Control: (A) Histogram, Pareto diagram, Fishbone diagram, Quality control chart-Testing required for quality control of construction material used in RCC Work- destructive and Non destructive Test (NDT) (B) Statistical Quality Control-Necessity, Benchmarking, Application of dispersion methods in quality control of construction activity.

Training and development of Human Resources: Training needs assessment, technical and managerial competencies necessary for achieving quality, preparation for training. Training on

Project Rework Reduction Tool (PRRT) software- training for preparation of checklist necessary for RCC work, for commonly used formats.

Unit-2

Development of quality circles, quality inspection team, inspection reports, monitoring and control, 360‘ feedback for quality.

Study of ISO 9004- Quality System Standards. Purpose of ISO Standards. Difference between ISO 9001 and ISO 9004.Certification process for ISO 9001. Certification bodies involved. Eight Principles of ISO-Basic meaning, applying these principles for an effective quality process in the organization. Management support and commitment necessary for achieving implementation for quality system standards.

Achieving TQM on Construction Projects: Advantages, barriers, principles, steps in implementation, seven types of construction defects. Determining cost of poor quality including hidden cost. Quality functions deployment (QFD). Importance of third party quality audits. CIDCCQRA quality rating systems, customers satisfaction surveys, Non Conformity reports (NCR), remedial strategy for reducing NCR‘s.

Unit 3

Construction Safety Management – Role of various parties, duties and responsibilities of top management, site managers, supervisors etc. role of safety officers, responsibilities of general employees, safety committee, safety training, incentives and monitoring. Writing safety manuals, preparing safety checklists and inspection reports.

Unit 4

Safety in construction operations – Safety of accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, etc. safety at various stages of construction. Prevention of accidents. Safety measures. Safety in use of construction equipment e.g. vehicles, cranes, hoists and lifts etc. safety of scaffolding and working platforms. Safety while using electrical appliances. Explosives used.

Unit 5

Various safety equipment and gear used on site. First aid on site, Safety awareness program. Labour laws, legal requirement and cost aspects of accidents on site, Incentive for safety practices. Study of safety policies, methods, equipment, training provided on any ISO approved construction Company ,safety in office, working on sites of high rise construction, deep excavation.

Books & References Recommended:

1) International Standards Organization – ISO 9001 and ISO 9004
2) 2. Mantri Handbook – A to Z of Construction – Mantri Publications
3) Juran‘s Quality Handbook – Joseph M. Juran, A. Blanton. Godfrey – Mcgraw Hill International Edition (1998).
4) Probability and Statistics for Engineers – Miller, Freund-Hall, Prentice India Ltd.

5) Quality Control and Total Quality Management, P.L.Jain, Tata Mcgraw Hill Publ.
6) Construction safety manual published by National Safety Commission of India.
7) Safety Management in Construction Industry – A manual for project managers. NICMAR Mumbai.
8) Construction Safety Handbook – Davies V.S.Thomasin K, Thomas Telford, London.
9) ISI for safety in Construction – Bureau of Indian Standrads.
10) Safety managementll –Girimaldi and Simonds, AITBS, New Delhi.

ELECTIVE II

CE 51311 : PRESTRESSED CONCRETE DESIGN

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) To explain the concept of pre-stressed concrete, methods and systems of pre-stressing, losses of pre-stress.
2) Analyse and design the sections for flexure, torsion and shear using different methods.
3) To design of sections for bond and anchorage and to calculate deflections of pre-stressed concrete beams.
4) Study the analysis and design of statically indeterminate beams.
5) Understand the analysis and design of axial members and slabs and grid floors.

COURSE OUTCOMES:

1) Illustrate fundamentals of pre-stressed concrete, methods and systems of pre- stressing and losses of pre-stress.
2) Analyse and design the sections for flexure, shear bond and anchorages.
3) Estimate the deflections of pre-stressed concrete elements.
4) Discuss the circular pre-stressing, analysis and design of statically indeterminate beams.
5) Solve the problems pertaining to axial members, slabs and grid floors.

Theory Content :

Unit – 1.

Introduction, Principles of prestressing, Different methods of prestressing – post tensioning and pre-tensioning.

Prestressed concrete materials. Need for high strength concrete and High concrete tensile steel. Creep and shrinkage of concrete, relaxation of steel. Losses of prestress friction and anchorage of steel.

Unit – 2.

Flexural strength of prestressed concrete section. Analysis of prestress, Resultant stress at a section, Line of Thrust, Load Balancing. Cracking moments.

Shear strength and torsional strength of prestressed concretes section. Principle stresses and principal shear stresses, Ultimate shear resistance.

Unit – 3.

Stress-pattern in anchorage zones. Transmission length. End zone reinforcement. Stress distribution in end block.

Unit – 4.

Design of members for flexure. Code recommendations. Rectangular and I-section. Working out of section dimensions for concrete and prestressing forces for steel. Application to design of slabs and continuous beams and Bridge girders. Design for concordant table and tendon profiles.

Unit – 5.

Design of tension and compression members, Design for combined bending and compressive, Different approaches for design, Introduction to design of transmission poles, roof truss members, purlin, railway sleepers.

Books & References Recommended:

1) Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley, New York, 1987.
2) N. Krishna Raju, “Prestressed Concrete”, Tata McGraw-Hill, New Delhi, 2001.
3) G.S. Pandit and S.P. Gupta, “Prestressed Concrete”, CBS Publications, New Delhi, 1995.
4) Lin T.Y., *Design of Prestressed Concrete Structures*.
5) Varatnam P., *Prestressed Concrete Structures*.
6) Ramaruthan S., *Prestressed Concrete*.
7) Graduate I.I., *Prestressed Concrete*.
8) Evans R.H. and Bennett R.S*., Prestressed Concrete*.
9) *IS-1343.*
10) Mullick S.K. and Rangaswamy R.S., *The Mechanics of Prestressed Concrete Design.*
11) Sinha and Raj, Prestressed Concrete.

CE 51312 : THEORY OF PLATES & SHELLS

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Analysis of rectangular and circular plates subjected to various loading conditions with different boundary conditions.
2) Explain fundamentals of buckling of plates.
3) Explain the concepts of small deflection theory of laterally loaded plates.
4) Discuss the approximate methods of analysis of rectangular plates.
5) Derive the governing differential equations for orthotropic plates and apply them to practical problems.
6) Explain the analysis and design of cylindrical shells, short and long shells.
7) Discuss the concepts of bending theory using D.K.J. equations and Schorer theory.
8) Define the beam theory and beam arch analysis.
9) Illustrate of the analysis and design of different shells of double curvature and axi-symmetrical shells by membrane theory.

COURSE OUTCOMES:

1) Analyse the rectangular and circular plates subjected to various loading conditions
2) Decipher the problems of buckling of plates with different edge conditions.
3) Solve the problems of small deflection theory of laterally loaded plates with different edge conditions.
4) Explain the various numerical and approximate methods for analysis of plate problems.
5) Apply the concepts of orthotropic plates to simply supported structures.
6) Analyse the cylindrical shells and design the short and long shells.
7) Solve the problems of bending theory using appropriate equations.
8) Evaluate and design the different shells using beam theory and membrane theory.

Theory Content :

Unit – 1.

Theory of plates **:** Bending of long rectangular plates to the cylindrical surfaces with different edge conditions. Pure bending of plates - Differential equations of equilibrium. Theory of small deflections of laterally loaded plates. Boundary conditions, moment - curvature relationship.

Unit – 2.

Analysis of rectangular plates. Navier's and levy type solutions, Exact theory of plates. Symmetrical bending of circular plates. Continuous rectangular plates.

Unit – 3.

Special and approximate methods of theory of plates, singularities, use of influence surfaces, use of infinite integrals and transforms, strain energy methods, experimental methods.

Unit – 4

Theory of shells **:** Classification of shells, Gaussian curvature, General theory of cylindrical shells, membrane theory and Bending theory for cylindrical shells. Long and short shells, shells, shells with and without edge beams. Fourrior loading.

Unit – 5.

Equations of equilibrium for shells of surface of revolution, Reduction to two differential equations of second order. Spherical shells, membrane theory for shells of double curvature-synclastic and anticlastic. Conoidal shells, Hyperbolic - parabolic shells, funicular shells.

Books & References Recommended:

1) S. Timoshenko and W. Krienger, “Theory of Plates and Shells”, McGraw-Hill, New York, 1959.
2) R.H. Wood, “Theory of Plates and Shells”, McGraw-Hill, New York, 2004.
3) O.C. Zienkiwicz, “Theory of Plates and Shells”, McGraw-Hill, New York, 1959.
4) G.S. Ramaswamy, “Design and Construction of Concrete Shell Roofs”, CBS Publications, New Delhi, 1986.
5) J. Ramchandran, “Thin Shells Theory and Problems”, Universities Press, Hyderabad, 1993.

CE 51313 : STRUCTURAL OPTIMIZATION

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Explain the optimization techniques and linear optimization.
2) Discuss the non-linear optimization and non-linear constrained optimization.
3) Explain the dynamic programming, decision theory and simulations.
4) Apply optimization techniques for simple structures.

COURSE OUTCOMES: The students will be able to

1) Explain optimization techniques, linear optimization, algorithm, etc.
2) Illustrate the nonlinear optimization-I and one dimensional minimization methods.
3) Explain the non-linear optimization-II by different methods.
4) Apply the optimization techniques for simple structures.

Theory Content :

Unit – 1.

INTRODUCTION : Design process, role of optimization in design, optimum design problem formulation : Variables, Constraint and objective function, Basic concepts of optimum design : Unconstrained and constrained optimum design problem, Global optimality, Post Optimality analysis.

Unit – 2.

OPTIMIZATION TECHNIQUES :

Traditional Approaches :

(a) Linear programming : problem, solution procedure, sensitivity analysis.

(b) Non-linear programming-kuhn-tucker conditions, single variable search, multivariable search, constrained optimization (Penalty function approach).

(c) Introduction to geometric and dynamic progamming.

Unit – 3.

OPTIMIZATION TECHNIQUES

Non traditional optimization techniques

Genetic algorithms – philosophy, positive features, operators.

Unit – 4.

STRUCTURAL OPTIMIZATION : Application of optimization in designing R.C.C. and Steel Structures.

(a) Optimal design of trusses and frames.

(b) Optimal design of thin walled columns under axial.

Unit – 5.

STRUCTURAL OPTIMIZATION : Application of optimization in designing R.C.C. and Steel Structures.

a) Compressive load panels subjected to in-plane compression and shear.

b) Grid Floor.

c) Box-beam under bending.

Books & References Recommended:

1) S.S. Rao, “Engineering Optimization”, New Age International, New Delhi, 1999.
2) J.O. Paul, “Systems Analysis for Civil Engineers”, John Wiley & Sons, 1988.
3) S.S. Bhavikatti, “Fundamentals of Optimum Design in Engineering”, New Age International, New Delhi, 2014.
4) S. Kalavathy, “Operation Research”, Vikas Publishing House, New Delhi, 2002.

CE 51314 : NUMERICAL AND SYSTEMS METHODS

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Explain special types of matrices, basic matrix operations and linear systems.
2) Define interpolation and discuss use of direct interpolation to approximate data and find derivatives.
3) Discuss Runge-Kutta 2nd order method for solving ordinary differential equations.
4) Illustrate various programming techniques
5) Discuss various rules of probability and statistics.

COURSE OUTCOMES: Students will be able to

1) Define and identify special types of matrices, perform basic matrix operations, and solve linear systems.
2) Define interpolation and use direct interpolation to approximate data and find derivatives.
3) Implement and use the Runge-Kutta 2nd order method for solving ordinary differential equations.
4) Illustrate various programming techniques
5) Apply various rules of probability and statistics.

Theory Content :

Unit – 1

Inversion of Matrix, Solutions of Simultaneous equations by elimination and Iterative methods. Solutions of ordinary differential equations by predictor corrector methods, Runge – Kutta Method.

Unit – 2

Backward, Forward and Central Difference methods, Interpolation, Extrapolation, Non-dimensionalisation. Application to partial differential equation. Summation of series, Numerical Integration and application to large elements.

Unit – 3

Introduction to optimisation, Mathematical programming techniques, Linear Programming, Integer Programming, Assignment and Transpiration Models, Dulity in L.P.

Unit – 4

Total Stage Decision Making Processes, Dynamic programming, Network Programming, Optimum project schedule, Regression Analysis.

Unit – 5

Random Variables, Discrete and Continuous Distributions, Empirical Distributions, Sampling, Point estimation, Bays Theorem, Statistical Tests of Significance.

Books & References Recommended:

1. Numerical Methods by *S.Balaguruswami, TMH Publ.*
2. Numerical Recipes in Fortran.
3. Numerical Methods in FEA by *Bathe and Wilson, PHI Publ.*
4. Operation Research by *Taha*
5. Operation Research Techniques for Management by *Benerjee, Business Book Publication House.*
6. Optimization Method in OR and system Analysis by *K.V.Mittal, Wiley Eastern Ltd.*

CE 51315 : RESEARCH METHODOLOGY

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Discuss the research types, methodology and formulation.
2) identify the sources of literature, survey, review and quality journals.
3) Discuss the research design for collection of research data.
4) Analyse the research data and write the research report and grant proposal.
5) To identify and apply appropriate research methodology in order to plan, conduct and evaluate basic research.
6) To compare between the scientific method and common sense knowledge while laying the foundation for research skills at higher levels.

COURSE OUTCOMES: The students will be able to

1) Illustrate the research types and methodology.
2) Do literature survey using quality journals.
3) Collect research data.
4) Process research data to write research report for grant proposal.

Theory Content :

I. Research: a) Types, Research process and steps in it, hypothesis, Research proposals and aspects. Research Methodology: Objectives of Research, Motivation in Research, Types of Research, Research Approaches, and Significance of Research. Research Methods Versus Methodology, Research and Scientific Method, Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem..

b) Research Design: Need, Problem Definition, variables, research design concepts, Literature .survey and review, Research design process, Errors In research. Data Collection and Representation: Primary Data Secondary Data, Data Presentation. Processing and Analysis of Data: Statistics in Research, Measures of Central Tendency,. Measures of Dispersion (variation), Measures of Asymmetry (Skewness), Measures of Relationship, Forecasting, Linear Regression and Time series.

c) Sampling Methods and Distributions: Sampling Methods, Sampling Distribution of mean, Sampling Distributions of Variance. Testing of Hypotheses-I : Basic Concepts Concerning

Testing ofHypotheses, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Important Parametric Tests, Limitations of the Tests of Hypotheses, Chi-square Test, Non Parametric Tests.

d) Research. Modelling: Types of Models, Model building and stages, Data consideration and testing; Heuristic and Simulation modelling, Simulation: Need for simulation, Types of' Simulation: Simulation languages.

e) Report Writing: Pre writing considerations„ Thesis writing, Formats of report writing, Formats of publications in Research journals. Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Report Format', Typing Instructions, Oral Presentation.

II. Design of Experiments: a) Objectives; strategies, Factorial experimental design, Designing engineering experiments, basic principles-replication, randomization, blocking, Guidelines for design of experiments.

b) Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components. Model adequacy checking. c) Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two-factor factorial design; Models-Effects, means and regression. Hypothesis testing.

Books & References Recommended:

1) C.R Kothari, “Research Methodology, Methods & Technique”, New Age International Publishers, New Delhi, 2004.
2) R. Ganesan, “Research Methodology for Engineers”, MJP Publishers, Chennai, 2011.
3) Ratan Khananabis and Suvasis Saha, “Research Methodology”, Universities Press, Hyderabad, 2015.
4) Y.P. Agarwal, “Statistical Methods: Concepts, Application and Computation”, Sterling Publishing Pvt. Ltd., New Delhi, 2004.
5) Vijay Upagade and Aravind Shende, “Research Methodology”, S. Chand & Company Ltd., New Delhi, 2009.
6) G. Nageswara Rao, “Research Methodology and Quantitative methods”, BS Publications, Hyderabad, 2012.
7) R.Panneerselvam , Research Methodology, PHI
8) Ranjit Kumar, Research methodology: a step-by-step guide for beginners, SAGE Publication. Ltd.
9) Montgomery, Douglas C;(2007), 5/e, Design and Analysis of Experiments, Wiley India)
10) Montgomery, Douglas C. & Runger; George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley Endia)
11) Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

CE 51316 : STRUCTURAL SAFETY AND RELIABILITY

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) To explain the basic concepts of structural reliability so that she/he can perform reliability-based structural analyses/evaluations and reliability-based design code calibrations.
2) To explain the theories and applications of reliability analysis of structural systems having uncertainty and/or exposed to random environment.
3) To discuss basic concepts of probability theory at the beginning which is followed by the Level-2 reliability methods.
4) To discuss the intricacies of Monte-Carlo simulation and its advanced versions for variance reduction and subset simulation.
5) To explain the applications of these methods for code calibrations and reliability analysis under multiple failure modes (i.e. system reliability).

COURSE OUTCOMES: The students will be able to

1) Analyse various uncertainties and their incorporation into analysis and design methods from the perspective of various levels of reliability-based analysis and design.
2) To discuss basic concepts of probability theory at the beginning which is followed by the Level-2 reliability methods
3) To explain the theories and applications of reliability analysis of structural systems having uncertainty and/or exposed to random environment.
4) To illustrate the intricacies of Monte-Carlo simulation and its advanced versions for variance reduction and subset simulation.

Theory Content :

Introduction to the concepts of uncertainty and reliability, Probability basics and random variables, Simulation techniques, Reliability analysis, Reliability-based design, System reliability, Introduction to advanced concepts.

COURSE DETAIL

S. No.	Topic	No. of Hours

1.	• Introduction to structural safety and reliability & reliability. • Concept of uncertainty in reliability-based analysis and design. • Course outline.	01
2.	• Random variables. • Probability axioms and probability functions. • Conditional probability. • Common probability distributions. • Correlation between random variables. • Random vectors and functions of random variables.	08
3.	• Monte Carlo simulation, • Latin Hypercube Sampling, • Variation reduction techniques. • Importance Sampling and Adaptive Sampling Subset	06
4.	• Level-2 Reliability Methods, • Failure Surface & Definition of Reliability in Std. Normal Space (Cornell's Reliability Index), • Concept of failure of a structure. • Reduced variable space and basic definition of reliability index. • First order second moment index. • Hasofer-Lind reliability index. • Rackwitz-Fiessler reliability index.	12
5.	• Reliability-based design code and its development. • Load and resistance factor design format. • Calibration of partial safety factors. • Uncertainty models for load and resistance. • Reliability Based Optimization	06

6.	• Implicit Performance Function, • Polynomial Response Surface Method (RSM) • Stochastic Response Surface Method (SRSM) • Second order reliability method. • Bayesian approach. • Response surface approach. • Time-varying reliability. • Case Studies Using MATLAB & ANSYS • Summary.	07

Books & References Recommended:

1) Andrzej S. Nowak & Kevin R. Collins, "Reliability of Structures", McGraw-Hill.
2) Papoulis A. Probability, Random Variables and Stochastic Processes, McGraw-Hill,New York, USA, 1991.
3) Ayyub B M, McCuen R H. Probability, Statistics and Reliability for Engineers andScientists, Chapman & Hall, Florida, USA, 2000.
4) Ranganathan R. Structural Reliability Analysis & Design. Jaico Publishing House,Mumbai, India, 1999.
5) Melchers R E. Structural Reliability: Analysis and Prediction, John Wiley, Chichester,1999.
6) Ang A H S & Tang W H. Probability Concepts in Engineering Planning and Design,Vol II, John Wiley, New York, 1984.
7) Madsen H O, Krenk S and Lind N C. Methods of Structural Safety, Prentice-Hall, Inc,Englewood Cliffs, USA, 1986.
8) Choi S K, Grandhi R V and Canfield R A. Reliability Based Structural Design, Springer-Verlag, London, UK, 2007.
9) Haldar A & Mahadevan S. Reliability Assessment Using Stochastic Finite Element Analysis, John-Wiely & Sons Inc., New York, USA, 2000.
10) Rackwitz R, Augusti G and Borri A. Reliability and Optimization of Structural Systems,Chapman & Hall, London, UK, 1995.
11) Waarts P H. Structural Reliability Using Finite Element Methods, Delft Univ. Press,Netherland, 2000.
12) Bucher C. Computational Analysis of Randomness in Structural Mechanics, CRCPress, London, UK, 2009.
13) Breitung K W. Lecture Notes in Mathematics, Springer-Verlag, Berlin, Germany, 1994

ELECTIVE III

CE 51717 : ANALYSIS AND DESIGN OF BRIDGES

PERIOD PER WEEK				CREDITS			MAXIMUM MARKS				
T	P	Tu.		T	P	Tu.	THEORY		PRACTICAL		TO MA
							CW	END SEM	SW	END SEM	
3	0	-		3	0	-	30	70	0	0	

COURSE OBJECTIVES:

1) Explain the hydraulic, geological and geo-technical aspects in bridge design.
2) Analyse, design and detail the bridge deck and box girder systems, steel and composite bridges.
3) Analyse and design the sub-structures, bridge bearings and various long span bridges.

COURSE OUTCOMES: The students will be able to

1) Explain the fundamentals and codes of practice of bridge design.
2) Design the bridge deck and box girder systems using appropriate method.
3) Design the steel truss and composite steel-concrete bridges.
4) Propose the sub-structure components such as pier, abutments, etc. and bridge bearings.
5) Design the various types of long span bridges, curved and skew bridges.

Theory Content :

Unit – 1.

General : Loadings and types of bridges, Site Selection, Economic Span. Introduction: Types of bridges - Materials of construction - Codes of practice (Railway and Highway Bridges) - Aesthetics - Loading standards (IRC, RDSO, AASHTO) - Recent developments box girder bridges - Historical bridges (in India and overseas). Planning and layout of bridges: Hydraulic design - Geological and geo- technical considerations - Design aids - Computer softwares- Expert systems.

Unit – 2.

R.C.C. : Design of simply supported solid slab bridge and girder bridge. Concrete bridges: Bridge deck and approach slabs - Slab design methods - Design of bridge deck systems - Slab-beam systems (Guyon-Massonet and Hendry Jaeger methods) - Box girder systems - Analysis and design - Detailing of box girder systems.

Unit – 3.

Steel : Design of Plate Girder and truss bridge (with Orthotropic deck). Steel and composite bridges: Introduction to composite bridges - Advantages and disadvantages - Orthotropic decks

- Box girders - Composite steel-concrete bridges - Analysis and design - Truss bridges. Behaviour of R.C.C. and Steel Box-Girder Bridges.

Unit – 4.

Sub-structure: Piers - Columns and towers - Analysis and design - Shallow and deep foundations - Caissons - Abutments and retaining walls. Bridge appurtenances: Expansion joints - Design of joints - Types and functions of bearings - Design of elastomeric bearings - Railings - Drainage system - Lighting.

Unit – 5.

Bearings, Piers and Abutments. Long span bridges: Design principles of continuous box girders - Curved and skew bridges - Cable stayed and suspension bridges - Seismic resistant design - Seismic isolation and damping devices. Construction techniques: Cast in-situ - Prefabricated - Incremental launching - Free cantilever construction - Inspection - Maintenance and rehabilitation - Current design and construction practices. Introduction to pre-stressed bridge

Books & References Recommended:

1) Wai-Fah Chen Lian Duan, "Bridge Engineering Handbook", CRC Press, USA, 2000.
2) R.M. Barker and J.A. Puckett, “Design of Highway Bridges”, John Wiley & Sons, New York, 1997.
3) P.P. Xanthakos, "Theory and Design of Bridges", John Wiley & Sons, New York, 1994.
4) D.J. Victor, “Essentials of Bridge Engineening,” Oxford & IBH Publishing, New Delhi, 2001.
5) N. Krishna Raju, “Design of Bridges,” Oxford & IBH Publishing, New Delhi, 1998.
6) T.R. Jagadeesh and M.A. Jayaram, “Design of Bridge Structures,” Prentice-Hall of India, New Delhi, 2006.

CE 51712 : COMPUTER AIDED ANALYSIS AND DESIGN

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Discuss the basics of programming languages FORTRAN-77/C++.
2) Illustrate Computer Graphics, Computer Graphics Co-ordination Systems. X-D windowing and clippling.
3) Computer Aided Analysis and Design of building, foundations and retaining structures : Design of shallow foundations; Pile Foundations, Retaining Walls.
4) Detailing of Concrete and Steel Structure

COURSE OUTCOMES: The students will be able to

1) Explain the basics of programming languages FORTRAN-77/C++.
2) Illustrate Computer Graphics, Computer Graphics Co-ordination Systems. X-D windowing and clippling.
3) Analyse and Design of building, foundations and retaining structures : Design of shallow foundations; Pile Foundations, Retaining Walls using computer.
4) Do detailing of Concrete and Steel Structure

Theory Content :

Unit – 1.

Programming Languages : Overview of programming languages FORTRAN-77/C++.

Unit – 2.

Computer Graphics : Introduction and applications point plotting and line generation, Computer Graphics Co-ordination Systems. X-D windowing and clippling.

Unit – 3.

Computer Aided Design : CAD in building Design and planning,

Unit – 4.

Construction Management Design and Detailing of Concrete and Steel Structure.

Unit – 5.

Computer Aided Analysis and Design of foundations and retaining structures : Design of shallow foundations; Pile Foundations, Retaining Walls.

Books & References Recommended:

1) Yashavant P. Kanetkar,' Let Us C++',BPB publications
2) V. Rajaram,' Computer Programming in Fortran 90 and 95' prentice hall of india private limited New Delhi,2010
3) Software Tutorials

CE 51713 : ANALYSIS AND DESIGN FOR DYNAMIC EFFECTS

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Discuss various degrees of freedom systems.
2) Discuss Earthquake Analysis and Design, Dynamic Interacting problems. Ground Structure Dynamic interaction.
3) Explain Wind induced Vibration of Structures. Fluid-structure dynamic interaction, Gust factors
4) Design of offshore structure.
5) Discussions of Indian Standard Codal provisions for wind and Earthquake resistant design of Buildings, Transmission towers, stack like structures and bridges.

COURSE OUTCOMES: The students will be able to

1) Explain various degrees of freedom systems.
2) Do Earthquake Analysis and Design and discuss Dynamic Interacting problems. Ground Structure Dynamic interaction.
3) Design of offshore structure.
4) Explain Indian Standard Codal provisions for wind and Earthquake resistant design of Buildings, Transmission towers, stack like structures and bridges.

Theory Content :

Unit – 1.

Systems with single degree of freedom – multi degree of freedom systems; vibrations of continuous elastic media – Beams, Plates.

Unit – 2.

Earthquake Analysis and Design, Dynamic Interacting problems. Ground Structure Dynamic interaction.

Unit – 3.

Wind induced Vibration of Structures. Fluid-structure dynamic interaction, Gust factors.

Unit – 4.

Introduction of to offshore structure design.

Unit – 5.

Study of Indian Standard Codal provisions for wind and Earthquake resistant design of Buildings, Transmission towers, stack like structures and bridges.

Books & References Recommended:

1) IS 1893
2) IS 875
3) Mohiuddin Ali Khan, “Earthquake Resistant Structures: Design, Build and Retrofit”, Elsevier Science & Technology, 2012.
4) Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, New Delhi, 2009.
5) Mario Paz, “Structural Dynamics”, CBS Publishers, New Delhi, 1987.
6) A.K. Chopra, “Dynamics of Structures”, Prentice Hall India, New Delhi, 1996
7) Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.

CE 51714 : Analysis & Design of Composite Structures : Steel, RCC, Timber

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) To Define the concept of steel - concrete composite member
2) To explain the behaviour of composite beams, columns.
3) To design composite girder bridges and understand the seismic behaviour of composite structures.
4) To design the connections.
5) To discuss specific case studies

COURSE OUTCOMES:

1) To explain to composite structural members and carry out the design of connections and girder bridges.
2) Propose the latest structural systems like composite constructions.

Theory Content :

UNIT 1 – INTRODUCTION

Introduction to Steel - Concrete Composite Construction - Theory of Composite Structures - Introduction to Steel - Concrete - Steel - Sandwitch Construction - Behaviour of composite beams and columns.

UNIT II - DESIGN OF COMPOSITE MEMBERS

Design of Composite beams – Design of Composite Columns - Design of Composite Trusses.

UNIT III - DESIGN OF CONNECTIONS

Types of Connections - Design of Connections in Composite structures - Shear Connections - Design of Connections in composite trusses.

UNIT IV - COMPOSITE GIRDER BRIDGES

Behaviour of girder bridges - Design concepts.

UNIT V - CASE STUDIES

Case Studies on steel - concrete composite construction structures in buildings - Seismic behaviour of composite structures and design methods.

Books & References Recommended:

1) "Teaching Resource Material for Structural Steel Design", Volume 2/3 jointly prepared by 1. I.I.T., MS 2. Anna University 3. SERC, MS 4. "Institute for Steel Development and growth", Calcutta.
2) Owens .G.W, & Knowels.P. "Steel Designs Manual", (sixth Edition) Steel Concrete Institute (UK) Oxford Black; well Scientific Publications, 2003.
3) Johnson.R.P, "Composite Structures of Steel and Concrete". Vol-I, # Oxford Black; well Scientific Publications (Third Edition) U.K. 2004.

CE 51715 : Design of Hydraulic & PHE Structures

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Perform the stability analysis and design of gravity dams.
2) Explain the causes of failure of different types of dams and their design criteria
3) Design of Storage Structures : Water Tanks – underground, elevated etc
4) Design of various components of Waste Water Treatment Plant & Sewage Treatment Plant
5) Design of spillways and concrete dams.

COURSE OUTCOMES: The students will be able to

1) Perform the stability analysis and design of gravity dams.
2) Explain the causes of failure of different types of dams and their design criteria
3) Design of Storage Structures : Water Tanks – underground, elevated etc
4) Design of various components of Waste Water Treatment Plant & Sewage Treatment Plant
5) Design of spillways and concrete dams.

Theory Content :

Unit-1

INTRODUCTION: Storage Scheme and their components, Types of Structures used. RESERVOIR PLANNING AND INVESTIGATION: Review of Reservoir Planning and Investigation Aspects, Reservoir Sedimentation, Measurement of Sediment Yield, Trap Efficiency, Distribution of Sediment, Life of Reservoir, Sedimentation Control, Apportioning of Costs of Multi-purpose River Valley Projects. DAMS: General Selection of type of Dam, Site Selection, Economic Size, Geological Investigations, Investigation Programme, Engineering Properties of Foundations, Foundation Treatment, River Diversion Aspects for Construction of Dam.

Unit-2

EARTH & GRAVITY DAMS: Introduction, Foundation for Earth Dams, Causes of failure, Design Criteria, Prevention of Embankment Corrosion, Seepage through dams, Phreatic Line, Stability of Slopes, Seepage Control through Foundations, Drainage in Earth Dams, Selection of Type of Earth Dam, Foundation Treatment, Maintenance of Earth Dams. ROCK FILL DAMS: Definition and Types, Foundation requirements and Treatment, Membrane cutoff, Embankment Design, Membrane Design. GRAVITY DAMS: General, Profile Shape, Forces acting on the Dam and

their Estimation, Earthquake forces and their Effects, I.S. Load Combinations, Design Concepts and Criteria, Gravity Method of Stability Analysis, Stress Analysis, Internal stresses, Openings in Gravity Dams and Stress Concentration Around Opening, Design of Galleries and Shafts, Joints and keys in Gravity Dams, Design of High Dams.

Unit-3

SPILLWAYS: Need, Functioning, Capacity Determination, detailed Design of Ogee Spillways, Introduction to Design of Syphon, Chute, Side Channel and Shaft Spillways, Considerations of Side Walls. GATES and VALVES: General, Types of Control Gates, Control Valves, Spillway Gates and their Functioning, Introduction to design of Radial Gates, Introduction to design aspects of Arch and Buttress Dams, Raising and Strengthening of Concrete Dams, Instrumentation in Dams, Economical Construction of Concrete Dams.

Unit-4

Design of various components of Waste Water Treatment Plant & Sewage Treatment Plant.

Unit-5

Design of Storage Structures : Water Tanks – underground, elevated etc.

Books & References Recommended:

1. Concrete Dams by R.S. Varshnay.
2. Concrete Dam by H.D. Sharma
3. Earth & Rock Fill Dams by Bharat Singh & H.D. Sharma.
4. Hand book of Dam Design by Golze.

CE 51716 : Blast Resistant Design of Structures

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Discuss Blast loading over ground and underground structures - design parameters - relevant BIS codes.
2) Design against blast and impact loading
3) Do Safety analysis and rating of various structures
4) Discuss techniques for optimal performance for artificial disasters under blast and impact.

COURSE OUTCOMES: The students will be able to

1) Explain Blast loading over ground and underground structures - design parameters - relevant BIS codes.
2) Design against blast and impact loading
3) Do Safety analysis and rating of various structures
4) Discuss techniques for optimal performance for artificial disasters under blast and impact.

Theory Content:

Blast loading over ground and underground structures - design parameters - relevant BIS codes.

DESIGN AGAINST BLAST AND IMPACT - Characteristics of internal and external blast - impact and impulse loads - pressure distribution on buildings above ground due to external blast - underground explosion - design of buildings for blast and impact as per BIS codes of practice.

Safety analysis and rating - Reliability assessment repairs and Retrofitting techniques of Community Structures - Protection of Nuclear Structures - Dams, bridges and buildings.

Materials for disasters reduction - Detailing aspects of structures subject to probable disasters - Construction techniques - Analysis methodology - Techniques for optimal performance - Provisions for artificial disasters - blast and impact.

Books & References Recommended:

1) Dowling, C.H, "Blast Vibration Monitoring and Control", Prentice Hall Inc., Englewood Cliffs, 1985.
2) Donald O. Dusenberry," Handbook for Blast Resistant Design of Buildings", John Wiley & Sons; 1 edition (28 January 2010)

ELECTIVE IV

CE 51761 : DESIGN OF TALL STRUCTURES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Explain Behaviour of Tall Structures under Static and Dynamic Loads, Model Analysis.
2) Analysis of wind and earthquake forces in tall structures
3) Analysis and design of Shear walls, Frame Structures, Coupled shear walls, Tabular Structures
4) Discuss the Criteria for design of Chimneys, T.V. Towers, and other Tall Structure.
5) Explain various Case Studies on tall structures

COURSE OUTCOMES: The students will be able to

1) Define Behaviour of Tall Structures under Static and Dynamic Loads, Model Analysis.
2) Analysis of wind and earthquake forces in tall structures**.**
3) Analysis and design of Shear walls, Frame Structures, Coupled shear walls, Tabular Structures**.**
4) List the Criteria for design of Chimneys, T.V. Towers, and other Tall Structure.
5) Explain various Case Studies on tall structures

Theory Content :

Unit – 1.

Behaviour of Tall Structures under Static and Dynamic Loads, Model Analysis.

Unit – 2.

Characteristics Wind and Earthquake Forces.
Gust Factor and Karman Vortices.
Approximate and Regorlons Methods of analysis for wind and Earthquake forces.

Unit – 3.

Shear walls, Frame Structures, Coupled shear walls, Tabular Structures, Ductility and reinforcement details at joint.

Unit – 4.

Criteria for design of Chimneys, T.V. Towers, and other Tall Structure.

Unit – 5.

Case Studies.

Books & References Recommended:

1) Bryan Stafford Smith, Alex coull, “Tall Building Structures, Analysis and Design”, John Wiley and Sons, Inc., 1991.
2) Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 2011
3) Lin.T.Y, Stotes Burry.D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.
4) Lynn S.Beedle, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
5) Wolfgang Schueller “High Rise Building Structures”, John Wiley and Sons, New York 1977.

CE 51762 : Non Linear Analysis of Structures

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

To provide an understanding of the nonlinear behaviour of structures, and to study the methods for analyzing nonlinear response of framed structures.

COURSE OUTCOMES: The students will be able to

1) Perform Elastic-Plastic analysis of trusses, beams & frames.
2) Discuss nonlinearities in structures and notation and Factors
3) Explain various Solution techniques
4) Geometrically nonlinear static analysis of frames
5) Explain nonlinear dynamic analysis.

Theory Content :

Unit 1

Introduction to nonlinearities in structures and notation, Factors influencing nonlinear response of structures a) Geometrical effects b) Material effects c) Instability phenomena Snap-through, Bifurcation, Post-buckling behaviour,

Unit 2

Elastic-Plastic analysis of trusses, beams & frames.

Unit 3

Geometrically nonlinear static analysis of trusses a) Member force-deformation relationships b) Member tangent stiffness matrices c) System equilibrium equations

Unit 4

Solution techniques - static analysis a) Linearized incremental procedures b) Iterative techniques c) Detection of instability

Unit 5

Geometrically nonlinear static analysis of frames a) Large rotations b) Analysis of individual members c) Member tangent stiffness matrices d) Solution techniques
Introduction to nonlinear dynamic analysis.

Books & References Recommended:

1) Steel Structures: Design and Behavior, fourth edition, Salmon, C.G., and Johnson, J.E., Harper Collins College Publishers, New York, 1996.
2) Steel Framed Structures: Stability and Strength, edited by R. Narayanan, Elsevier Applied Science Publishers, New York, 1985.
3) Elastic Instability Phenomena, Thompson, J.M.T., and Hunt, G.W., John Wiley and Sons, New York, 1984.
4) Beams and Beam-Columns: Stability and Strength, edited by R. Narayanan, Elsevier Applied Science Publishers, New York, 1983.
5) Nonlinear Structures, Majid, K.I., John Wiley and Sons, Inc., New York, 1972.
6) Theory of Elastic Stability, Timoshenko, S.P., and Gere, J.M., 2nd ed., McGraw-Hill Book Co., Inc., New York, 1961.

CE 51763 : ADVANCED PRESTRESSED CONCRETE DESIGN

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Explain the concept of pre-stressed concrete, methods and systems of pre-stressing, losses of pre-stress.
2) Analyse and design the sections for flexure, torsion and shear using different methods.
3) Discuss the design of sections for bond and anchorage and deflections of pre-stressed concrete beams.
4) To analyse and design of statically indeterminate beams.
5) To analyse and design of axial members and slabs and grid floors.

COURSE OUTCOMES:

1) Explain the fundamentals of pre-stressed concrete, methods and systems of pre-stressing and losses of pre-stress.
2) Analyse and design the sections for flexure, shear bond and anchorages.
3) Estimate the deflections of pre-stressed concrete elements.
4) Explain the circular pre-stressing, analysis and design of statically indeterminate beams.
5) Solve the problems pertaining to axial members, slabs and grid floors.

Theory Content :

Unit – 1.

Introduction: Basic concepts - Materials - Permissible stress – Systems of prestressing – Losses in pre-stress. Design: Analysis and design of PSC beams for flexure using elastic and limit state methods.

Unit – 2.

Deflections: Importance of deflections - Factors influencing deflections - Codal provisions - Short term and long term deflections. Shear: Shear in principal stresses – Cracked and uncracked sections - Codal provisions – Design of shear reinforcement. Torsion and bond: Torsion for cracked and uncracked sections - Codal provisions and design – Bond - Codal provisions expressions and design.

Unit – 3.

End blocks: Nature of stresses - Stress distribution – Magnel and Guyol's Methods - Codal provisions - Design. Continuous beams: Advantageous of continuous members – Codal provisions – Design of two span and three span Continuous beams – Concordant cable profiles.

Unit – 4.

Tension members: Introduction - Ties - Circular prestressing – Design of PSC pipes and tanks. Compression members: Introduction – Design of PSC columns - Poles and piles.

Unit – 5.

Slabs: Introduction – Types – Circular, rectangular and flat slabs – Cracking and strength – Codal provisions – Design of PSC floor slabs - One way and two way slabs and simple flat slabs. Grid floors: Introduction – Analysis and design of PSC grid floor systems.

Books & References Recommended:

1) Arthur H. Nilson, "Design of Prestressed Concrete", John Wiley, New York, 1987.
2) N. Krishna Raju, "Prestressed Concrete", Tata McGraw-Hill, New Delhi, 2001.
3) G.S. Pandit and S.P. Gupta, "Prestressed Concrete", CBS Publications, New Delhi, 1995.

CE 51764 : DESIGN OF OFF-SHORE STRUCTURES/MARINE STRUCTURES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) To explain the behaviour of structures subjected to hydrodynamic loads.
2) To discuss different analysis procedures for different offshore structures and also explain the wave structure interaction.

COURSE OUTCOMES:

1) Explain the functions and behaviour of offshore structures.
2) Illustrate the behaviour of waves and its effects on structures.
3) Evaluate the behaviour of structures for its dynamic loads.

Theory Content :

UNIT 1

Loads on Offshore Structures - Wind Loads; Wave and Current Loads; Calculation based on Maximum base Shear and Overturning Moments; Design Wave heights and Spectral Definition; Hydrodynamic Coefficients and Marine growth; Fatigue Load Definition and Joint Probability distribution; Seismic Loads.

UNIT 2

Concepts of Fixed Platform Jacket and Deck - Jacket concepts, redundant framing arrangement; Launch and Lift jackets; Simple Deck configurations for Lift and float-over installations; In-service and Pre-service Loads and analysis.

UNIT 3

Steel Tubular Member Design - Principles of WSD and LRFD; Allowable stresses and Partial Safety Factors; Tubular Members, Slenderness effects; Column Buckling, Design for Hydrostatic pressure; Design for combined axial and bending stresses (API RP 2A guidelines).

UNIT 4

Tubular Joint Design for Static and Cyclic Loads - Simple tubular joints, design using allowable loads; stress concentration factors; S-N curves and fatigue damage calculations.

UNIT 5

Submarine Pipelines and Risers - Route selection and Diameter / wall thickness calculations; Pipeline stability, free span calculations; Concrete coated pipelines and pipe-in-pipe insulated pipelines; Design using DNV 81 code.

Design against Accidental Loads (Fire, Blast and Collision) - Behavior of steel at elevated temperature; Fire Rating for Hydrocarbon fire; Design of structures for high temperature; Blast Mitigation-Blast walls; Collision of Boats and energy absorption; Platform survival capacity and Plastic design methods.

Books & References Recommended:

1. Hydrodynamics of Offshore Structures by S.K. Chakrabarti, Springer-Verlag
2. Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.
3. Offshore pipelines by B. Gou, S. Song, J. Chacko and A. Ghalambor,Â GPP Publishers,2006
4. Structural Stability - Theory and Implementation by W.F.Chen and E.M.Lui by Elsevier.
5. Interim Guidance Notes for the design of and protection of topside structures agains explosion and fire, Joint Industry Research, UK.

CE 51765 : Advance Construction Practices

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

1) Discussion on various power generating structures.
2) Explain construction techniques of bridges
3) Explain different methods and techniques of construction of Underground and over ground structures
4) Illustrate techniques of construction of high rise building
5) Techniques of construction of offshore structures

COURSE OUTCOMES: The students will be able to

1) Explain construction techniques of various power generating structures.
2) Explain construction techniques of bridges
3) Explain different methods and techniques of construction of Underground and over ground structures
4) Illustrate techniques of construction of high rise building.
5) Techniques of construction of offshore structures

Theory Content :

Unit 1

Construction of power generating structures – Atomic Power stations, Thermal power stations. Co - generation Power Plant , Windmills, Transmission towers, Chimneys (single and multi-flue), cooling towers - Natural draft cooling towers (NDCT) & Induced draft cooling tower (IDCT), Ash handling system, Containment Structure, Electro Static Precipitator (ESP), Case study of Kaiga atomic power station, Madras atomic power station. Or Any other Case Study and Safety Hazards

Unit 2

Bridges, Steel Bridges, Arch Bridges, Cantilever Bridges Segmental construction & Box Girders. Construction of special type of bridges such as cable stayed bridge, suspension and Pre-stressed bridge, construction of foundation and Super structure.

Unit 3

Construction of Metro Railway & Monorail - Underground and over ground structures, different methods and techniques of construction. Problems and solutions – during maintenance and

upkeep of structures. Fire, Ventilation , Dewatering and power supply, Subsidence, Vibration etc., Concept of Magrail.

Unit 4

High rise buildings – Construction methods and techniques using different materials, Minerals, Admixtures in-situ concrete, Precast Concrete & Structural Steel, finished concrete, tunnel form, fire Fighting ,Safety & Hazards, Job Safety Analysis. Innovative methods of construction – Slip form technology, Jump form technology, Aluform & Tunnel Form Technology, Dry wall technology, Plastering Machines.

Unit 5 Offshore structure such as- Beacons, Oil drilling Platforms, light houses. Barges- Jackup Platform, Deck Barge, Hydro clam barges, Hoppers Barges, Submersible barges, Function, utilization & economics of barges.

Dredging System, Mechanism, Hydraulic dredger in waves, Water & Booster System, Dredging in navigation system, Agitation dredging system, silt dredging system, water injection system, Pneumatic dredging system, Amphibious & scrapper dredging system, Advantages & Disadvantages of Various Dredging System , Production Cycle for Dredgers, Application, Capacity of dredgers, & its economical use, dredging economics.

Books & References Recommended:

1) Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.
2) Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
3) Construction Equipment Planning and Applications – Dr. Mahesh Varma.
4) Manuals, brochures, publications from construction companies, firms etc.
5) Reports of actual works executed.
6) NICMAR Publications on Construction Engineering
7) Dr. Kumar Neeraj Jha, — Formwork for Concrete Structures‖, Mc Graw Hill Publication.

CE 51766 : REPAIR, MAINTENANCE AND REHABILITATION OF STRUCTURES

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu.	T	P	Tu.	CW	END SEM	SW	END SEM	
3	0	-	3	0	-	30	70	0	0	100

COURSE OBJECTIVES:

Discuss quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.

COURSE OUTCOMES:

Explain quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.

Theory Content :

UNIT I : MAINTENANCE AND REPAIR STRATEGIES

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT II : STRENGTH AND DURABILITY OF CONCRETE

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness.

UNIT III : SPECIAL CONCRETES

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Geo-polymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

UNIT IV : TECHNIQUES FOR REPAIR AND PROTECTION METHODS

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT V : REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – DEMOLITION TECHNIQUES – Engineered demolition methods – Case studies.

Books & References Recommended:

1) Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical UK, 1991.
2) Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987.
3) Shetty M.S., “Concrete Technology – Theory and Practice”, S.Chand and Company, 2008.
4) Dov Kominetzky.M.S., “Design and Construction Failures”, Galgotia Publications Pvt. Ltd., 2001.
5) Ravishankar.K., Krishnamoorthy.T.S, “Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures”, Allied Publishers, 2004.
6) CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
7) Gambhir.M.L., “Concrete Technology”, McGraw Hill, 2013