K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

F. Y. M.Tech
Pattern 2022 Semester: I
CIV225101: Numerical Methods in Structural Engineering

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	InSem Exam: 20Marks Continuous Comprehensive Evaluation: 20Marks EndSem Exam:60Marks

Prerequisite Courses, if any: Engineering Mathematics- Calculus, Differential equations, Linear algebra, introductory knowledge of probability and statistics.

Course Objectives:

1. To introduce students to classical numerical methods available for engineering problem-solving
2. To expose students to concepts such as precision, errors and tolerances and their effect on the quality of the solutions produced by scientific computing
3. To improve programming skills and familiarize students with the computer as an engineering and simulation tool
4. To enhance fundamental understanding of concepts acquired in algebra, calculus and differential equations

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Identify various numerical methods for performing tasks, such as interpolation, differentiation, integration, solution of linear and nonlinear equations, solution of differential and integral equations.	1
CO2	Discuss the techniques, skills, and modern engineering tools necessary for engineering practice.	2
CO3	Apply numerical methods to obtain approximate solutions to mathematical problems.	3
CO4	Analyze and evaluate accuracy of various numerical methods and their applicability.	4
CO5	Formulate algorithms and programming.	5

COURSE CONTENTS

Unit I	**Introduction to Matlab and solution of equations and eigen value problems**	**8**	**CO1, CO2, CO3**

Introduction to MATLAB, MATLAB window, Various command used in command window, Matrices in MATLAB, Steps in writing a MATLAB program, Array, Function of MATLAB Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method Gauss elimination method –Gauss Jordan method –Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method

Unit II	**Numerical Solutions of Differential Equations**	**8**	**CO1, CO2, CO4**

Ordinary Differential Equations [ODE] Taylor series method, Euler Method, Runge-Kutta fourth order,

Simultaneous equations using Runge-Kutta 2nd order method			
Unit III	**Numerical differentiation and integration**	**8**	**CO1, CO2, CO3**
Trapezoidal rule, Simpson's 1/3rdRule, Simpson's 3/8thRule, Gauss Quadrature 2 point and 3 point method. Double Integration Trapezoidal rule, Simpson's 1/3 rd Rule.			
Unit IV	**Curve Fitting and Regression Analysis**	**8**	**CO3, CO4**
Least square method, polynomial functions, curve fitting. Interpolation – Polynomial approximation, Lagrange's method, spline interpolation.			
Unit V	**Finite difference method**	**8**	**CO3, CO5**
Forward, backward and centered finite difference approximations to the derivatives. Applications to indeterminate beams, columns and plates.			

TextBooks

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

ReferenceBooks

1. E. Ward Cheney, David R. Kincaid, Numerical Methods and Applications, Brooks Cole
2. Cengage Learning India
3. S. C. Chapra, R. P. Canale, Numerical Methods for Engineering, TMH Publications
4. E. Balgurusamy, Numerical Methods, TMH Publications

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	2	3	3	1	1
CO 2	3	2	3	3	1	1
CO 3	3	2	3	3	1	1
CO 4	3	2	3	3	1	1
CO 5	3	2	3	3	1	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignments	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

F. Y. M.Tech
Pattern 2022 Semester: I
CIV225102: Structural Dynamics

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	InSem Exam: 20Marks Continuous Comprehensive Evaluation: 20Marks EndSem Exam: 60Marks

Prerequisite Courses, if any: Engineering Mathematics-Limits, Differentiations, Integrations.

Course Objectives:

1. To understand fundamental concepts of vibration analysis.
2. To analyse damped and undamped SDOF subjected free and forced vibrations.
3. To illustrate development of response spectra and different methods of nonlinear structural response.
4. To edify MDOF subjected free and forced vibrations.
5. To learn design of machine foundations and techniques of vibration response control.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Solve single degree of freedom systems subjected to free and forced vibrations.	2
CO2	Demonstrate development of response spectra and its significance in seismic analysis.	2
CO3	Apply fundamental theory of structural dynamics and equation of motion to field problems	3
CO4	Evaluate response of multi degree of freedom systems subjected to free and forced vibrations.	4
CO5	Formulate dynamic analysis of single and multi-degree-of-freedom systems using MATLAB programs / software.	5

COURSE CONTENTS

Unit I	**Introduction to Structural Dynamics**	**8**	**CO1, CO3, CO5**

Importance of vibration analysis, difference between static and dynamic loading, nature of exciting forces, Fundamental concepts of vibrations, dynamic equilibrium of motion, stiffness and damping, degrees of freedom, mathematical modelling, SDOF systems subjected to free vibrations – undamped and damped.

Unit II	**Single degree of freedom systems**	**8**	**CO1, CO3, CO5**

Single degree of freedom systems subjected to forced vibrations: undamped and damped, SDOF systems subjected to harmonic loading, resonance, response to support motion, force transmitted to the foundation, transmissibility.

Unit III	**Response spectrum**	**8**	**CO1, CO2, CO3, CO4, CO5**
Response to general dynamic loading, Duhamel's integral, pulse loadings, step and ramp functions, Numerical evaluation of Duhamel's Integral, direct integration of the equations of Motion, Response spectrum- theory and development of response spectra, Codal provisions.			
Unit IV	**Non-linear structural response**	**8**	**CO3, CO4, CO5**
Non-linear structural response- constant acceleration method, linear acceleration method, Newmark-β method, Wilson- θ method. MDOF systems (Lumped parameter)- Formulation of mass, stiffness and damping matrices (upto 3 DOF), Determination of natural frequencies and mode shapes. Dynamic response by modal superposition method, Dynamic analysis of beams.			
Unit V	**MDOF system**	**8**	**CO3, CO4, CO5**
MDOF system (Distributed parameter) -Development of equation of motion, Single span beams, free and forced vibration response, Natural frequencies and mode shapes of uniform beams. Applications of structural dynamics - Design of machine foundations for harmonic loading, Vibration isolation. Introduction to techniques of vibration response control. Vibration control of SDOF system.			

Text Books

1.Mario P., and Kim, Y. N., 'Structural Dynamics- Theory and Computation', 6 th edition, Springer Publications.

2. Chopra, A. K., 'Dynamics of Structures - Theory and Applications to Earthquake Engineering', Pearson.

Reference Books

1.Clough and Penzien, J., 'Dynamics of Structures', Computers & Structures, Inc., University Ave, Berkeley, USA

2. Mario P. and William L., 'Structural Dynamics - Theory and Computation', Updated With Sap 2000, Kluwer Academic Publishers.

3. Roy D. and Rao G., 'Elements of Structural Dynamics: A New Perspective', John Wiley and Son, 2012.

4. Gary H. and Kevin W., 'Structural Dynamics for Structural Engineers', John Wiley and Sons.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	2	3	3	1	1
CO 2	3	2	3	3	1	1
CO 3	3	2	3	3	3	1
CO 4	3	2	3	3	1	1
CO 5	3	3	3	3	2	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

F. Y. M.Tech
Pattern 2022 Semester: I
CIV225103: Solid Mechanics

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	InSem Exam: 20Marks Continuous Comprehensive Evaluation: 20Marks EndSem Exam: 60Marks

Prerequisite Courses, if any: Engineering Mathematics, Strength of Materials, Structural Mechanics

Course Objectives:

1. To give knowledge about stress and strain.
2. To educate about generalized equation of Hooke's law.
3. To illuminate compatibility between stress and strain.
4. To explain the concepts of torsion.
5. To enhance the knowledge about plasticity.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand principles of elasticity and plasticity to be used for the analysis of structures.	1
CO2	Define basic definitions of continuum mechanics, such as deformations, strains, stress.	2
CO3	Solve simple elasticity problems.	2
CO4	Apply the principles of solid mechanics to solve complex problems.	3
CO5	Analyze torsion in bars and pressure in cylinders.	4

COURSE CONTENTS

Unit I	**Analysis of Stress and Strain**	**8**	**CO1, CO3, CO5**

Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition.

Unit II	**Stress-Strain Relations**	**8**	**CO1, CO3, CO5**

Generalized Hook's law, plane stress, plane strain Problems in 2D Cartesian coordinate system, Airy's stress function, relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress- strain relationship, Strain displacement relationship for plane stress and plane strain conditions.

Unit III	**Axisymmetric Problems and Torsion**	**8**	**CO1, CO2, CO3, CO4, CO5**

Equilibrium equations, Strain displacement relations, Stress- strain relationship, Stress compatibility equations, Plane stress and Plane strain conditions. Cylinders subjected to internal and external pressure

Assumptions and Torsion equation for general prismatic solid bars, warping of Non-circular sections and St. Venant's theory, Prandtle's stress function approach. Torsion of Circular, Elliptical and Triangular cross-section bar.

Unit IV	**Introduction to Plasticity**	**8**	**CO3, CO4, CO5**

Stress - strain diagram - Ideal plastic body - Illustration of plastic Analysis - Yield criteria - Rankine's theory - St.Venant's theory - Tresca Criterion - Beltramis theory - Von Mises criterion - Mohr's theory of yielding - Yield surface - Flow rule (stress - strain relation for perfectly plastic flow)- Prandtl Reuss equality - plastic work - stress - strain relation based on Tresca – plastic potential - uniqueness of a stress distribution - strain hardening.

Unit V	**Plastic analysis of Thick Cylinder**	**8**	**CO3, CO4, CO5**

Elasto-plastic problems of beams in bending – thick hollow spheres and cylinders subjected to internal pressure – General relations - plastic torsion –Nadai's and heap analogy

Text Books

1. Mohammed Ameen, "Computational Elasticity", Narosa Publishing House, 2005.
2. Arvind Kumar Singh., "Mechanics of Soilds", Prentice Hall of India, 2007.

Reference Books

1. Sadhu Singh, Theory of Elasticity, Khanna Publishers.
2. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill Publications
3. Chakrabarty J, Theory of Plasticity, McGraw-Hill Publications.
4. Timoshenko and Goodier, Theory of Elasticity, McGraw-Hill Publications.

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	3	2	1	--
CO 2	3	1	3	2	1	--
CO 3	3	1	3	2	1	--
CO 4	3	1	3	2	1	--
CO 5	3	1	3	2	1	--

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	**10**
2	Mini Project	**10**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

F. Y. M.Tech
Pattern 2022 Semester: I
CIV225104-A: Advanced Design of Steel Structures

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	InSem Exam: 20Marks Continuous Comprehensive Evaluation: 20Marks EndSem Exam: 60Marks

Prerequisite Courses, if any: Engineering Mathematics, Engineering Mechanics, Structural Analysis, Design of Steel Structures

Course Objectives:

1. To bestow knowledge of steel structures, hoarding structures, microwave towers.
2. To impart knowledge about analysis of transmission towers.
3. To teach the analysis of tubular structures.
4. To explain the concepts and design of castellated beams.
5. To edify the knowledge about water tanks.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand basics of hoarding structure and castellated beams and learning to choose the desired member after analysis	1
CO2	Compare different types of microwave towers and analyzing them as per given parameters.	2
CO3	Analyze transmission towers by making use of concepts of engineering mechanics and structural analysis.	4
CO4	Design tubular structures and cold form light gauge sections by making use of concepts of trigonometry and steel structures.	5
CO5	Design water tanks, staging, foundation and anchor bolts.	5

COURSE CONTENTS

Unit I	**Hoarding Structures, Castellated Beams**	**8**	**CO1**
Analysis of hoarding structures under dead, live and wind load. Concepts, fabrication, advantages, disadvantages and design of castellated beams for bending and shear by limit state method.			
Unit II	**Microwave towers**	**8**	**CO2**
Introduction, various structural configurations, function and analysis of microwave towers for dead, live and wind loads.			
Unit III	**Transmission towers**	**8**	**CO3**
Introduction, structural configuration, bracing systems, analysis of transmission tower for normal operating conditions, top most power conductor in broken condition and ground wire in broken condition.			
Unit IV	**Tubular structures, Cold-form light guage sections**	**8**	**CO4**
Design of tubular trusses using circular hollow, rectangular hollow sections as per code, detailing of			

joints. Cold form light gauge section: Advantage, type of cross section, stiffened, multiple stiffened and un-stiffened element, flat-width ratio, effective design width, design of light gauge compression, tension and flexural members as per code.			
Unit V	**Water tanks**	**8**	**CO5**
Design of rectangular riveted steel water tank, Tee covers, Plates, Stays, Longitudinal and transverse beams, Design of staging, Base plates, Foundation and anchor bolts.			

Text Books

1.MRaghupathi, Design of steel structures, Tata McGraw Hill, New Delhi.

2. S K Duggal, Limit state design of steel structures, Tata McGraw Hill Education.

Reference Books

1. Ram Chandra, Design of steel Structures, Volume II, Standard Book House, New Delhi.

2. Punmia and Jain, Comprehensive Design of steel structure, Laxmi Publication, New Delhi.

3. N Subramanian, Design of steel structures, Oxford University Press.

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	2	3	3	1	1
CO 2	3	2	3	3	1	1
CO 3	3	2	3	3	1	1
CO 4	3	2	3	3	1	1
CO 5	3	2	3	3	1	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	**10**
2	Mini Project	**10**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: I
CIV225104-B: Optimization Techniques

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**InSem Exam: 20Marks** **Continuous Comprehensive Evaluation: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: Engineering Mathematics

Course Objectives:

1. To understand the mathematical tools that are needed to solve optimization problems
2. To apply the theory of optimization methods for solving various types of optimization problems
3. To enumerate the fundamental knowledge of Linear Programming problems.
4. To Learn classical optimization techniques and numerical methods of optimization
5. To edify the knowledge about Replacement models.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Discuss the application of various Optimization Techniques in Civil engineering project	**2**
CO2	Apply appropriate classical optimization method to obtain optimum solution	**3**
CO3	Formulate Linear programming problem for Civil engineering problems and obtain optimum solution	**3**
CO4	Apply concept of Transportation and Assignment Model to compute the cost of an optimum route between various sources and destination.	**3**
CO5	Apply appropriate numerical iterative method to obtain optimum solution and assess the useful life of Equipment using replacement model technique.	**3**

COURSE CONTENTS

Unit I	**Introduction**	**8**	**CO1**

Introduction to optimization techniques, Applications to various civil engineering problems, Introduction to Linear and Non-linear programming methods (with reference to objective function, constraints)

Unit II	**Classical optimization methods**	**8**	**CO2**

Single and multiple problems with equality and inequality constraints, Hessian matrix and its use, Lagrangian method, Convex and concave functions

Unit III	**Linear programming**	**8**	**CO3**

Formulation of Linear Programming Problem, Standard LP problem, Assumptions in LP, Graphical solutions of LP problem, Simplex method to solve LP problems, Use of big M and two phase method.			
Unit IV	**Additional topics in Linear programming**	**8**	**CO4**
Transportation problem, Assignment problem, Mathematical methods of transportation and assignment problem, Methods of solution, Variation in transportation and assignment problems such as unbalanced problem			
Unit V	**Numerical iterative methods and Replacement model**	**8**	**CO5**
One dimensional non linear functions without constraints, Dichotomous, Fibonacci and golden section search methods. Replacement of items whose maintenance and repair cost increase with time, ignoring time value of money.			

Text Books

1. Prem Kumar Gupta, D.S. Hira , Operations Research, S. Chand & Company, New Delhi.
2. V K Kapoor, Operation Research, Sultan Chand & Sons, New Delhi.

Reference Books

1. Operations Research by Hamdy A.Taha
2. Engineering Optimization byS.S.Rao
3. Quantitative Techniques in Management by N.D. Vohra (Mc Graw Hill)
4. A System Approach to Civil Engineering Planning & Design by Thomas K.Jewell (Harper RowPublishers)
5. Introduction to Operations Research by by Hillier and Lieberman, Mc Graw Hill

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	-	-	-	2	-
CO 2	3	-	-	-	2	-
CO 3	3	-	-	2	2	-
CO 4	3	-	-	2	2	-
CO 5	3	-	-	-	2	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: I
CIV225104-C: Structural Design of Precast Concrete Structures

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	InSem Exam: 20Marks Continuous Comprehensive Evaluation: 20Marks EndSem Exam: 60Marks

Prerequisite Courses, if any: Structural Analysis, Structural Design of RC structures

Course Objectives:

1. To understand the precast concrete design and its material.
2. To describe the concepts of bond on different types of concrete with precast concrete and Use of different tools.
3. To illustrate the design of different precast members i.e. floors and beams
4. To learn the design of precast members of Columns and Shear Wall
5. To consider the mechanism of Joints and its Connections.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Enumerate the Precast concrete construction and use of different materials.	2
CO2	Compare the concepts of bond on different types of concrete with precast concrete and use of different tools.	2
CO3	Apply the design of Precast construction for different precast members i.e floors and beams	3
CO4	Calculate the design of precast members of Columns and Shear Wall	3
CO5	Formulate the mechanism of Joints and its Connections.	4

COURSE CONTENTS

Unit I	**History and Development**	**8**	CO1, CO3, CO5

a) History and Development of Precast concrete construction, Advantages and disadvantages of precast concrete construction; general principles of design; mechanical handling of large projects like stadium, bridges etc.

b) Materials viz. Concrete, Self Compacting Concrete, Grout, Reinforcement and structural welded wire cages. Requirements of industrialized buildings, standardization of precast elements and unification of building design. Influence of manufacture, transport and erection technologies on design solution

Unit II	**Ferrocement and other raw materials**	**8**	CO2, CO3, CO5

a) Definition, basic concept like bond increase, comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement, special types of ferrocement. Ferrocement as substitute for conventional building materials. typical characteristics and their applications.

b) Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants.

Unit III	**Precast Floors and Beams**	**8**	CO1, CO2, CO3

a) Precast Concrete Floors: Precast flooring options-flooring arrangements-design of individual units-design of composite floors- Beams and roof elements

b) Precast Concrete Beams: Types of composites -non composite-reinforced beam -pre stressed beam

Unit IV	**Columns and Shear Wall**	**8**	CO4, CO5

Precast column design -precast shear walls- infill walls-cantilever walls -distribution of horizontal forces

Unit V	**Joints and Connections**	**8**	CO4, CO5

a) Joints: Basic mechanism-compression joint-shear joint - tension joint.

b) Connections: Pin jointed connection-moment resisting connections- beam to column- column foundation connections.

Text Books

1. Promyslolw, V. Design And erection of Reinforced Concrete Structures,MIR Publishers, Moscow 1980
2. Koncz.T., Manual of Precast Concrete Construction, Vol.I, II and III, Bauverlag, GMBH, 1971.

Reference Books

1. Hass A.M., Precast Concrete – Design and applications Applied Science, 1983.
2. David Sheppard –Plant cast, Precast and Prestressed concrete, McGraw Hill; 1989
3. NBC – 2005 (Part I to Part VII) BIS Publications, New Delhi, IS 15916- 2011,IS 11447,IS6061 – I and III
4. R. P. Johnson: Composite Structure of Steel and Concrete (Volume 1), Blackwell Scientific Publication (Second Edition), U.K., 1994.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	1	3	1	1
CO 2	3	2	1	2	1	1
CO 3	3	2	2	3	2	2
CO 4	3	2	2	3	2	2
CO 5	3	2	3	3	2	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: I
CIV225104-D: Structural Design of Concrete Bridges

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**InSem Exam: 20Marks** **Continuous Comprehensive Evaluation: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: Prestressed concrete

Course Objectives:

1. To study the various bridge forms and typical loadings on the bridges.
2. To get familiarized with the design of short span and long span bridges.
3. To design the pre-stressed concrete bridges.
4. To design of different bridges with different types of bearings and its connections.
5. To design the substructure for bridges with different types foundations.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Interpret the design theories for super structure and Sub structure of bridges.	**2**
CO2	Design short span bridges and long span bridges using different theories	**5**
CO3	Design prestressed concrete bridges	**5**
CO4	Design of different types of bearings and its connections.	**5**
CO5	Design of abutments, piers and various types of foundations for bridges.	**5**

COURSE CONTENTS

Unit I	**Elements of Bridge**	**8**	CO1, CO2, CO3

General basic bridge forms - Beam, arch, suspension, various types of bridges, selection of type of bridge and economic span length, drainage, road, kerb, classification, investigation and planning. design loads for bridges - Dead load, live load, IRC loading, IRS loading, Aashto loading, wind load, longitudinal forces, centrifugal forces, buoyancy, water current forces, thermal forces deformation and horizontal forces

Unit II	**Design of Deck slab bridge**	**8**	CO1,CO2, CO3

Design of Deck slab bridge - T-Beam girder bridge - Pigeaud's Theory - Courbon's Method - Design of box culvert (Principles only).

Design principles of continuous bridges - Box girder bridges and balanced cantilever bridges - cable

stayed.

Unit III	**Design of PSC Bridges**	**8**	CO1, CO2, CO3

Flexural and Torsional parameters - Courbon's Theory - Distribution Coefficient by exact analysis - Design of girder section - maximum and minimum prestressing forces - Eccentricity - Live load and dead load shear forces - Cable Zone in Girder - Check for stresses at various sections - Check for diagonal tension - Diaphragms - End Block -Short term deflections

Unit IV	**Classification and Design of Bearings**	**8**	CO2, CO4

Metallic bearings, Elastomeric bearings, POT and PTFE bearings.

Unit V	**Abutment and Pier**	**8**	CO1,CO4, CO5

Analysis and Design of Abutment and Pier. Introduction to Design of Open Well, Pile and Caisson Foundations.

Text Books

1. Ponnuswamy, S "Bridge Engineering", Tata McGraw-Hill, 2008.
2. Jagadeesh, T. R. and Jayaram, M. A., "Design of Bridge Structures", Prentice Hall of India Pvt Ltd., 2004.

Reference Books

1. Johnson Victor, D, "Essentials of Bridge Engineering", Oxford & IBH, 2007.
2. Raina, V. K., "Concrete Bridge Practice", Tata McGraw Hill Publishing Company, New Delhi, 1994.
3. Bakht, B and Jaegar, L.G., "Bridge Analysis Simplified", McGraw Hill, 1985.
4. Derrick Beckett, "An Introduction to Structural Design of Concrete Bridges", Surrey University Press, Henley Homes, Oxford Shire 1973.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	1	2	1	--
CO 2	3	2	3	3	2	1
CO 3	3	2	3	3	2	1
CO 4	3	2	3	3	2	1
CO 5	3	2	3	3	2	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: II
CIV225105: Research Methodology and Intellectual Property Rights

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**InSem Exam: 20Marks** **Continuous Comprehensive Evaluation: 20Marks** **EndSem Exam: 60Marks**

Course Objectives:

1. To familiarize with basics of research and the research process
2. Understand the steps followed in research
3. Analyze the information related to research
4. Understand the concepts, procedure of IPR.
5. Understand the concepts, procedure of Patent Rights

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Develop understanding on objectives of doing research and research process.	**2**
CO2	Apply the subject knowledge in formulating a research problem	**3**
CO3	Understand the different steps involved in research in order to develop effective report writing skill	**2, 3**
CO4	Disseminate knowledge on IPR, patents, patent regime in India and abroad and registration aspects	**2**
CO5	To enable the students to keep their IP rights alive.	**3**

COURSE CONTENTS

Unit I	**Research problem**	**8**	CO1, CO2, CO3

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Unit II	**Steps in Research**	**8**	CO1,CO2

Steps in Research: Identification, selection and formulation of research problem- Research Questions- Research design- Formulation of hypothesis- Review of literature. Definition, Necessity and techniques of defining research problem, Formulation of research problem.

Unit III	**Effective technical writing**	**8**	CO2, CO3, CO4, CO5

Effective technical writing, how to write report and Research Paper. Developing a Research Proposal, Format of research proposal, Plagiarism.

Unit IV	**Basics of Intellectual Property Rights**	**8**	CO4, CO5
Introduction to the concepts, Property and Intellectual Property, objective and Importance of Intellectual Property Rights, Patents, Process of Patenting and Development: technological research, innovation patenting and development, Procedure for grants of patent. International Scenario: WIPO, TRIPs, Patenting under PCT.			
Unit V	**Patent System and New developments in IPR**	**8**	CO4, CO5
Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Administration of Patent System, New developments in IPR; IPR of Biological Systems, Computer Software etc.			

Text Books

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers,.
2. Ranjit Kumar, Research Methodology: A Step□by□Step Guide for Beginners, 2nd Edition, SAGE, 2005

Reference Books

1. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013.
2. Singh, Y. K. (2006). Fundamental of Research Methodology and Statistics. New Delhi. New International (P) Limited, Publishers.
3. Best and Kahn, Research Methodology, PHI Limited
4. Miles, Huberman, A. M., Saldana J. Qualitative data analysis: A methods sourcebook – Third edition, Sage Publication.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age, Aspen Law & Business.

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	3	1	1	-
CO 2	3	1	3	1	1	-
CO 3	3	1	3	1	1	-
CO 4	3	1	3	1	1	-
CO 5	3	1	3	1	1	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignments	10
2	Draft patent writing	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: I
CIV225106: Lab Practice 1

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 04 hrs/week	02	TW: 25Marks OR: 25Marks

Prerequisite Courses, if any: Testing of concrete ingredients, basics of MATLAB

Course Objectives:
1. To understand and apply MATLAB.
2. To demonstrate the experimental techniques in recent development in concrete.
3. To characterize the dynamic properties of a structure such as natural frequencies and mode shapes.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Apply MATLAB for solving engineering problems	3
CO2	Perform mix design of special concretes.	3
CO3	Assess the properties of fresh and hardened concrete.	3
CO4	Perform experiments on shake table.	3

COURSE CONTENTS

I	**Analysis of Systems**	2	CO1
Dynamic analysis of single and multi-degree-of-freedom systems using MATLAB programs / software.			
II	**Mix Design**	2	CO2
High performance/High strength/Self compacting concrete			
III	**Properties of Fresh Concrete**	2	CO3
Testing of Properties of fresh Concrete (High performance/High strength/Self compacting concrete/ pumpable concrete)			
IV	**Properties of hardened Concrete**	2	CO3
Testing of hardened Concrete (High performance/High strength/Self compacting concrete/ pumpable concrete			
V	**Structural Dynamics: Experiments**	2	CO4
Determine the natural frequencies and the mode shapes for various shear building frames subjected to harmonic base excitations			

Text Books

1. A.P.Remideos, Concrete Mix Design, Himalaya Publishing House
2. P. Kumar Metha, Concrete, Gujrat Ambuja.

Reference Books

1. M.S. Shetty, Concrete Technology, S. Chand Publications.
2. A R Santhakumar, Concrete Technology, Oxford University Press.
3. M. L. Gambhir, Concrete technology, TataMcgraw Hill Publications.
4. P. N. Balguru and P. N. Shah, Fiber Reinforced Cement Composite.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	3	3	3	2	1
CO 2	3	2	3	3	3	2
CO 3	3	2	3	3	3	3
CO 4	2	2	3	2	2	2

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Assignment I	**1**
2	Assignment II	**2**
3	Assignment III	**3**
4	Assignment IV	**3**
5	Assignment V	**4**

Guidelines for Term work Assessment

1.Assessment will be based on each unit.
2. Each assignment will be of 5 marks.

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: II
CIV225107: Theory of Plates and Shells

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**InSem Exam: 20Marks** **Continuous Comprehensive Evaluation: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: Engineering Mathematics, Strength of Materials, Solid Mechanics (Theory of Elasticity and Plasticity)

Course Objectives:

6. To give knowledge of classical and Navier's plate theory.
7. To convey knowledge about Levy's and Reissener – Mindlin theories for plates.
8. To teach the analysis of circular plates under axi-symmetric loading.
9. To explain the concepts of shells and shell of revolution.
10. To furnish the knowledge about circular cylindrical shells.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand basics of plates and shells and studying various types of theories related to plates and shells.	**1**
CO2	Compute moment curvature relations of plates and shells.	**2**
CO3	Learn to analyze circular plates for different loading conditions.	**3**
CO4	Evaluate stress displacement relations and strain displacement relations in plates and shells.	**3**
CO5	Learn to formulate governing differential equation and study bending theory in plates and shells.	**3**

COURSE CONTENTS

Unit I	**Classical plate theory, Navier's plate theory**	**8**	CO1, CO2, CO3

Introduction: Thin and thick plates, small and large deflections, small deflection theory of thin plates: assumptions, moment curvature relations, stress resultants, governing differential equation in Cartesian co-ordinates, various boundary conditions, pure bending of plates. Analysis of rectangular plates: Navier solution for plates with all edges simply supported, distributed loads, point loads and rectangular patch load.

Unit II	**Levy's method, Reissener – Mindlin theory**	**8**	CO1,CO2, CO4

Levy's Method: Distributed load and line load, plates under distributed edge moments. Raleigh- Ritz approach for simple cases in rectangular plates. Introduction to shear deformation theories, Reissener - Mindlin theory, moment curvature relationship for First order shear deformation theory.

Unit III	**Circular Plates**	**8**	CO1, CO2, CO3
Circular Plates: Analysis of circular plates under axi-symmetric loading, moment curvature relations, governing differential equation in polar co-ordinates. Simply supported and fixed edges, distributed load, ring load, a plate with a central hole.			
Unit IV	**Introduction to Shells**	**8**	CO3, CO4
Introduction: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations. Shells of revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.			
Unit V	**Circular Cylindrical Shell**	**8**	CO4, CO5
Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions. Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions and application to pipes and pressure vessels.			

Text Books

1. Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition
2. Chandrashekhara K., Analysis of Plates, New Age International Edition

Reference Books

1. S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.
2. Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill
3. G. S Ramaswamy, Design and Construction of Concrete Shell Roofs, CBS Publications

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	3	1	1	-
CO 2	3	1	3	1	1	-
CO 3	3	1	3	1	1	-
CO 4	3	1	3	1	1	-
CO 5	3	1	3	1	1	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: II
CIV225108: Finite Element Method

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	InSem Exam: 20Marks Continuous Comprehensive Evaluation: 20Marks EndSem Exam: 60Marks

Prerequisite Courses, if any: Engineering Mathematics-Matrix operations, Structural Analysis

Course Objectives:

1. To learn basic principles of finite element analysis procedure
2. To learn the theory and characteristics of finite elements that are used in the analysis of engineering structures.
3. To develop the knowledge and skills needed to analyse structural problems by using finite element method.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Demonstrate effect of type of element on the accuracy of the solution.	**2**
CO2	Solve structural engineering problems using 1D, 2D and 3D elements.	**2**
CO3	Write shape functions of 1D, 2D and 3D elements	**3**
CO4	Differentiate plate elements and shell elements as per its application.	**2**
CO5	Construct stiffness matrix for isoparametric and axisymmetric elements.	**4**

COURSE CONTENTS

Unit I	**Introduction**	**8**	CO1, CO2

General steps of finite Element Method, applications and advantages, various element shapes, discretisation of continuum, node numbering, use of polynomial displacement function, Pascal's triangle. Convergence criteria, formulation of stiffness matrix, boundary conditions, analysis of spring assemblage. Element stiffness matrix for truss and beam element; Analysis of truss, beam and portal frames by using direct stiffness approach.

Unit II	**Formulation**	**8**	CO1,CO2

Background on variational calculus, Galerkin method, collocation method, least squares methods, Variational methods of approximation, Rayleigh-Ritz method, Variational theorem, principle of minimum potential energy, variational approach for formulation of element stiffness matrix for truss and beam elements, Strong and Weak formulation.

Unit III	**Two dimensional elements**	**8**	CO2, CO3

Two dimensional elements in plane stress / plane strain problems. CST, LST and rectangular elements, Shape functions in Cartesian and natural coordinate systems, shape functions for one, two and three dimensional elements. Higher order elements- Lagrange –Serendipity – Interpolation-formulation of element stiffness.

Unit IV	**Concept of Various Elements**	**8**	CO2, CO5
Concept of isoparametric elements, Jacobian matrix, formulation of two dimensional quadrilateral isoparametric element in plane elasticity problem, 3-D isoparametric elements, Axisymmetric elements in axisymmetric problems, stress strain relations, triangular and Quadrilateral elements.			
Unit V	**Thin Plate Bending Elements**	**8**	CO4, CO5
Thin Plate bending elements, various triangular and rectangular elements, ACM (Adini, Clough, Melosh) and BFS (Bogner, Fox, Schimdt) elements. Conforming and nonconforming elements, concept of four noded and eight nodded isoparametric elements, Mindlin's hypothesis for plate bending element, Flat and curved shell element, elements for cylindered shells			

Text Books

1. Logan, D.L., 'A First Course in Finite Element Method', Cengage Learning.
2. Rao, S. S., 'The Finite Element Method in Engineering' Elsevier Publication.

Reference Books

1. Buchanan, G. R., 'Finite Element Analysis', Schaum's outlines, Tata McGraw Hill Publishing Co. Ltd.
2. Zienkiewicz& Taylor, 'The Finite Element Method', Vol. I & II – McGraw Hill International Edition
3. Bhavikatti, S. S., 'Finite Element Analysis', New Age International Publishers, Delhi
4. Reddy, J. N., 'An Introduction to the finite element method', Tata McGraw Hill Publishing Co. Ltd.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	2	3	3	3	-
CO 2	3	2	3	3	3	-
CO 3	3	2	3	3	3	-
CO 4	3	2	3	3	3	-
CO 5	3	2	3	3	3	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: II
CIV225109: Advanced Design of Concrete Structures

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**InSem Exam: 20Marks** **Continuous Comprehensive Evaluation: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: Basic Mathematics, Concrete Technology, Reinforcement Cement Concrete Structures

Course Objectives:

1. To grant knowledge of yield line theory.
2. To teach the analysis and design of reinforced concrete grid slab, flat slab, deep beams and curved beams
3. To explain the concepts and design of elevated service reservoir.
4. To edify the knowledge of design of advanced foundations.
5. Understand techniques and method of communicating engineering design to industry.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply relevant IS provisions to ensure safety and serviceability of structures.	**3**
CO2	Predict the behavior of structural elements under working and ultimate loads.	**5**
CO3	Apply the principles, procedures for the design of special reinforced concrete structures.	**3**
CO4	Prepare drawings of structural detailing.	**6**

COURSE CONTENTS

Unit I	**Yield line theory**	**8**	CO1, CO2, CO3

Yield line theory for analysis of slabs, various patterns of yield lines, assumptions in yield line theory, characteristics of yield lines. Design of various slabs such as rectangular, triangular, circular with various edge conditions using yield line theory, Design for limit state of strength and serviceability of orthotropically reinforced slabs.

Unit II	**Grid Slabs and Flat Slabs**	**8**	CO1, CO2, CO4

Grid and coffered slabs, general features, design of grid floor by approximate method.

Flat slabs, types, design methods, column and middle strip, proportioning of flat slab element, total design moment, distribution of moments, effect of pattern loading, design for shear, design of intermediate and end panel by direct method only.

Unit III	**Reinforced Concrete Beams**	**8**	CO1, CO2, CO3

Design of reinforced concrete deep beams, design of beams curved in plan.

Unit IV	**Elevated service reservoir**	**8**	CO3, CO4
Elevated service reservoir: Rectangular and circular type only flat bottom, Design of staging for wind and earthquake forces.			
Unit V	**Foundations**	**8**	CO3, CO5
Design of raft foundations, pile foundations, single pile, group of piles, Pile cap. Combined footing – Slab type rectangular combined footing, slab-beam type rectangular combined footing.			

Text Books

1. Shah, V. L. and Karve, S. R., 'Limit State Theory & Design of Reinforced Concrete', Structures Publications, Pune.
2. Bhavikatti S. S., 'Advance R. C. C. Design', New Age International Publishers

Reference Books

1. Park R. and Paulay T., 'Reinforced Concrete Structures', John Wiley & Sons.
2. Purushothaman P., 'Reinforced Concrete Structural Elements', Tata McGraw-Hill, 1984
3. Pillai S. U. and Menon D., 'Reinforced Concrete Design', Tata McGraw-Hill.
4. Varghese P. C., 'Advanced Reinforced Concrete Design', Prentice-Hall of India.

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	2	3	3	1	1
CO 2	3	2	3	3	1	1
CO 3	3	2	3	3	1	1
CO 4	3	2	3	3	1	1
CO 5	3	2	3	3	1	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: II
CIV225110-A : Analysis & Design of Earthquake Resistant Structures

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**InSem Exam: 20Marks** **Continuous Comprehensive Evaluation: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: Engineering Mechanics, Structural Analysis, Dynamics of structure, Design of RCC structure.

Course Objectives:

1. To make students to learn basic seismology & its effects on structure
2. To study the effect of irregularities on behavior of structure & philosophy of earthquake resistant design
3. To expose the students to the analysis and design principles of Earthquake resistant structures using code provisions.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Describe basic seismology and earthquake design philosophy.	**1**
CO2	Apply the basic engineering concepts related to earthquake Engineering.	**3**
CO3	Evaluate seismic forces for various structures as per relevant Indian standards.	**5**
CO4	Design the structures for seismic resistance as per Indian standards.	**6**
CO5	Design ductile detailing in the structural members.	**6**

COURSE CONTENTS

Unit I	**Basic seismology and earthquake effects**	**8**	CO1, CO2

Definition of earthquakes, causes of earthquakes, theories of earthquakes, seismic zones, generation of seismic waves and its composition, measurement of earthquakes seismic effects on structures liquefaction and its effects on structures, peak ground acceleration, peak velocity, peak displacement, response spectra, tripartite plot, soil structure-interaction.

Unit II	**Earthquake design philosophy**	**8**	CO1, CO2

Effect of irregularities and architectural planning, center of mass and center of rigidity, philosophy of earthquake resistant design, maximum considered earthquake, design-based earthquakes, concept of stiffness, flexibility and ductility, P-Delta effects.

Unit III	**Methods of analysis**	**8**	CO1, CO2, CO3

Equivalent linear static analysis (with numerical), modal spectral analysis (with numerical), linear time history analysis, static pushover analysis, capacity-based design, performance-based design, IS1893 code provisions

Unit IV	**Design of RC members**	**8**	CO3, CO4, CO5
Load combinations, concept of strong column and weak beam design, design and detailing of beam, column and beam-column joints as per IS 1893 and IS13920.			
Unit V	**Design of Shear wall & Analysis of elevated water tanks**	**8**	CO3, CO4, CO5
a) Design of shear wall: types of lateral load resisting systems, (types of shear walls) computation of design lateral forces on RC shear wall, design of RC shear wall b) Analysis of elevated water tanks: Modelling and analysis of overhead water tanks, hydrostatic and hydrodynamic effects, earthquake resistant provisions.			

Text Books

1. PankajAgarwal,ManishShrikhande, Earthquakeresistantdesignofstructures, PHIIndia
2. S.K.Duggal,EarthquakeResistant DesignofStructures, OxfordUniversityPress.

Reference Books

1. MinoruWakabayashi, DesignofEarthquakeResistantBuildings, McGrawHill Publications.
2. T. Paulay and M J N Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings,John Wiley and Sons.
3. D. J. Dowrick, Earthquake Resistant Design and Risk, Reduction Willey India, 2011
4. J A Blume, Design of multi-story RC Buildings for Earthquake Motions, Newmark and Coming, Portland Cement Association.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	2	1	1	1	1
CO 2	3	2	1	1	1	1
CO 3	2	2	3	3	2	2
CO 4	2	2	3	3	3	3
CO 5	2	2	3	3	3	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: II
CIV225110-B: Structural Design of Steel Bridges

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory : 03 hrs/week	03	InSem Exam: 20Marks Continuous Comprehensive Evaluation: 20Marks EndSem Exam: 60Marks

Prerequisite Courses, if any: Engineering Mechanics, Structural Analysis, Dynamics of structure, Design of RCC structure.

Course Objectives:

1. To classify the components of bridges and understand the usage of respective IS codes
2. To design and analyze plate girder bridges
3. To design truss design with standards.
4. To design cable supported steel bridges and design of steel box girder.
5. To understand the box section of flexural members knowing each component in detail

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Categorize different components of bridges and quote the respective standard specifications	2
CO2	Interpret the box section and its types devising the proportioning limits.	2
CO3	Analyze and Design beam, plate girder bridges, truss bridges and cable support steel bridges.	4

COURSE CONTENTS

Unit I	**Introduction**	**8**	CO1, CO3

Introduction to bridge engineering, classification and components of bridges, layout, planning, structural forms of bridge decks, beam and slab decks, cellular decks, standard specification for bridges, IRC loadings for road bridges, loading standards for railway bridges, analysis of through type and deck type bridges

Unit II	**Beams**	**8**	CO1, CO3

Analysis and design of beam, Design of plate girder bridges, main plate girder, shape limitation based on local buckling, lateral torsional buckling, web buckling, shear moment interaction, fatigue effect, Lateral bracing

Unit III	**Truss Bridges**	**8**	CO1, CO3

Design of truss bridges, optimum depth of truss girder, design of compression chord member, design of tension chord member, design of vertical and diagonal member, Lateral bracing

Unit IV	**Cable Supported Steel Bridges**	**8**	CO1, CO3

Design of cable supported steel bridges, design of steel box girder, design of suspension cables, Suspension bridges.

Unit V	**Box section flexural members**	**8**	CO1, CO2
Box section flexural members, diaphragm requirements at support, bearing, top lateral bracing in tube girder, horizontally curved boxes, single boxes, closed boxes, proportioning limits			

Text Books

1. Demetrios E. T., Design, Rehabilitation and Maintenance of Modern Highway Bridges, McGraw-Hill Publishers.
2. Ramchandra, 'Design of Steel Structures 2', Scientific Publications

Reference Books

1. Owens. G. W., Knowles. P. R., Dowling. P. J., Steel Designers Manual, Fifth edition, Blackwell Scientific Publications.
2. Chatterjee S., The Design of Modern Steel Bridges, First edition, BSP Professional books.
3. Victor. D. J. Essentials of Bridge Engineering, Oxford and IBH Publishers.
4. T. R. Jagadeesh and M. A. Jayaram, Design of Bridge Structures, Prentice-Hall of India

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	2	2	2	--
CO 2	3	1	3	3	2	1
CO 3	3	2	3	3	2	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
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M.Tech
Pattern 2022 Semester: II
CIV225110-C: Structural Reliability

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs/week	**03**	**InSem Exam: 20Marks** **Continuous Comprehensive Evaluation: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: Design of structures

Course Objectives:

1. To study design & development of problem solving skills
2. To study the probability Concept
3. To study the different probability distributions
4. To study the principles of reliability & reliability analysis
5. To study the concepts of system reliability

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply knowledge of design and development of problem solving skills	**3**
CO2	Understand the probability Concept	**2**
CO3	Summarize and apply the probability distributions for given data	**2**
CO4	Express the principles of reliability	**3**
CO5	Integrate the concept of System reliability	**5**

COURSE CONTENTS

Unit I	**PreliminaryDataAnalysis**	**8**	CO1

Graphicalrepresentation-Histogram,frequencypolygon,Measuresofcentraltendency- grouped and ungrouped data, measures ofdispersion, measures of asymmetry. Curve fitting andCorrelation:Fittingastraightline, curve of the formy=nd,andparabola,Coefficientofcorrelation

Unit II	**ProbabilityConcepts**	**8**	CO1, CO2

Randomevents - Samplespace and events, Venn diagram and event space, Measuresofprobability-interpretation,probabilityaxioms,additionrule,multiplicationrule,conditionalprobability,probabilitytreediagram,statisticalindependence,totalprobabilitytheoremandBaye'stheorem.

Unit III	**Random variables**	**8**	CO2, CO3

Probability mass function,
Probabilitydensityfunction,Mathematicalexpectation,Chebyshev'stheorem.Probabilitydistributions:Discretedistributions-Binomialandpoisondistributions,Continuousdistributions-
Normal,Lognormaldistributions

Unit IV	**ReliabilityAnalysis**	**8**	CO4, CO5
Measuresofreliability-factorof safety,safetymargin,reliabilityindex,performancefunction and limiting state. ReliabilityMethods-FirstOrderSecondMomentMethod(FOSM),PointEstimateMethod(PEM),and Advanced First OrderSecondMomentMethod(Hasofer-Lind'smethod)			
Unit V	**System reliability**	**8**	CO4, CO5
Influence of correlation coefficient,redundantandnon-redundantsystems-series, parallel and combined systems, Uncertainty inreliabilityassessments-Confidencelimits,Bayesianrevisionof reliability. SimulationTechniques: MonteCarlo simulation- Statistical experiments, sample sizeandaccuracy,Generationofrandomnumbers-random numbers with standard uniform distribution,continuousrandomvariables,discreterandomvariables.			

Text Books

1. Ranganathan, R., "Structural Reliability Analysis and design"- Jaico l Publishinghouse,Mumbai,India.
2. AchintyaHaldar and SankaranMahadevan, "Probability, Reliability andStatisticalmethodsinEngineeringdesign"-JohnWileyandSons.Inc.

Reference Books

1. Aug, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planninganddesign"-Volume-I,JohnWileyandsons,Inc,NewYork.
2. Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineeringplanning
3. anddesign"-Volume-II,JohnWileyandsons,Inc,NewYork.
4. Milton,E.Harr(1987). "Reliabilitybaseddesignincivilengineering"-McGrawHillbookCo.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	2	1	1	2	1
CO 2	3	2	1	1	2	1
CO 3	2	2	3	1	2	1
CO 4	2	1	3	3	3	1
CO 5	2	1	3	3	3	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignment	10
2	Mini Project	10

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

M.Tech
Pattern 2022 Semester: II
CIV225111: Lab Practice 2

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 04 hrs/week	**02**	**TW: 25Marks** **OR: 25Marks**

Prerequisite Courses, if any: Testing of concrete ingredients, basics of MATLAB

Course Objectives:

1. To demonstrate the advanced techniques for structural health assessment of buildings.
2. To use computer aided programs and softwares for analysis of structures.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Examine structural health and stability of buildings.	**2**
CO2	Model and analyze different types of problems in structural engineering using finite element programs/software packages.	**3**

COURSE CONTENTS

I	**NDT Tests:**	**2**	CO1

Rebound Hammer Test
Ultrasonic Pulse Velocity Method
Half Cell Potentiometer Test

II	**Structural Audit of Building**	**2**	CO1

A group of maximum four students should select any old existing building and carry out structural audit of a building using NDT Tests and Visual Inspections and prepare a report.

III	**Computer implementation of FEM procedure**	**2**	CO2

Pre-processing, solution, Post-processing, Use of commercial FEA software, development of computer programs using one dimensional and two dimensional elements.

Text Books

1. S. S. Bhavikatti, Finite Element Analysis – New Age International Publishers, Delhi
2. S. S. Rao, The Finite Element Method in Engineering 4th Edition – Elsevier Publication.

Reference Books

1. C. S. Krishnamoorthy, Finite Element Analysis: Theory & Programming, Tata McGraw Hill Publishing Co. Ltd
2. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure,Vol□ 1, Taylor and Francis Group, London, U.K, 2006.
3. Zienkiewicz& Taylor, The Finite Element Method 4th Edition: Vol. I & II – McGraw Hill

International Edition
4. G. R. Buchanan, Finite Element Analysis Schaum's outlines, Tata McGraw Hill Publishing Co. Ltd.

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	3	3	3	3	3
CO 2	3	2	3	3	3	2

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Assignment I	**1**
2	Assignment II	**1**
3	Assignment III, IV, V	**2**
Guidelines for Term work Assessment		
1.Assessment will be based on each unit. 2. Each assignment will be of 5 marks.		

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

F. Y. M.Tech
Pattern 2022 Semester: II
CIV225112: Seminar I

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 04 hrs/week	02	TW: 25Marks OR: 25Marks

Prerequisite Courses, if any: Structural Mathematics, Structural Dynamics, Solid Mechanics, advanced design of structure, knowledge about analysis and design software.

Course Objectives:

5. Identify structural engineering problems reviewing available literature
6. Identify appropriate techniques to analyze complex structural systems
7. Demonstrate application of engineering and management principles through efficient handling of project.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Select topic of own choice based on theory subjects learned during first semester.	1
CO2	Identify an engineering problem, analyze it and propose work plan to solve it.	2
CO3	Review and tabulate the Literature related to area of the topic	3
CO4	Demonstrate Analysis and design of the project by application of engineering and management principles	4
CO5	Write Seminar report of topic and communicate effectively in both verbal and written form in standard format	5

COURSE CONTENTS

Unit I	**Topic selection and introduction to topic**	**4**	**CO1**
Seminar I: Shall be on state of the art topic of student's own choice based on semester I subject i.e. Structural Mathematics, Structural Dynamics, Solid Mechanics, advanced design of structure and give brief introduction of topic			
Unit II	**Problem formation**	**4**	**CO2**
The student has to state problem statement of the topic			
Unit III	**Literature survey**	**12**	**CO3**
The student has to complete literature survey related to area of the topic			
Unit IV	**Analysis and design of the project**	**20**	**CO4**
The student has to demonstrated work by doing analytical and software study related to area of the topic			
Unit V	**Seminar report**	**8**	**CO5**
The student shall submit the duly certified seminar report (printed on both sides) in standard format			

Text Books
1. Borden, Iain and Katerina Ruedi Ray. The Dissertation: A Guide for Architecture Students. Third Edition. 2014.

Reference Books
1. Turabian, Kate L. A manual for writers of term papers theses, and dissertations. 7th ed., 2007. 2. John Bowden, Writing A Report, 9th Edition: How to Prepare, Write & Present Really Effective Reports, June 2011.

	Strength of CO-PO/PSO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	3	3	3	3
CO 2	3	1	3	3	3	3
CO 3	3	1	3	2	3	2
CO 4	3	1	3	3	3	3
CO 5	3	3	3	3	3	3

Guidelines for Term work Assessment
Review I- 50 marks, Review-II- 50 marks, Final report – 50 Marks. Total of 150 marks will be converted to 25 marks.

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

F. Y. M.Tech
Pattern 2022 Semester: II
CIV225113: Computer Aided Design

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 04 hrs/week	02	Continuous Comprehensive Evaluation: 25Marks OR: 25Marks

Prerequisite Courses, if any: Engineering Mathematics-Limits, Differentiations, Integrations.

Course Objectives:

6. To understand fundamental spreadsheet
7. To learn analysis and design using programming
8. To edify knowledge using MATLAB

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the basics of spreadsheet, programming and MATLAB	2
CO2	Develop computer programs using a language and MATLAB.	2
CO3	Apply MATLAB for solving engineering problems	3

COURSE CONTENTS

Unit I	**Analysis and Design of Structures using Spreadsheet**	**8**	**CO1**
Defining constants, variables, different functions as per requirement, pulling data from tables, using logical and relational operators, analysis and design of different elements of steel and RCC structure			
Unit II	**Analysis and Design of Structures using Programming**	**8**	**CO2, CO3**
Defining constants, variables, different functions as per requirement, using arrays and loops, using logical and relational operators, analysis and design of different elements of steel and RCC structure			
Unit III	**Basics of MATLAB**	**8**	**CO2, CO3**
MATLAB environment for technical computing, basic mathematical functions, Arrays and Array Operations, Vector arrays, matrix arrays, relational and logical operators, loops.			
Unit IV	**MATLAB Functions and Operations**	**8**	**CO2, CO3**
Mathematical functions and applications, user defined functions, plotting functions, curve fitting, integration and differentiation, symbolic expressions and algebra, file input output operations.			
Unit V	**Computer Implementation**	**8**	**CO2, CO3**
Development of simple programs. Application to engineering problems			

Text Books

1. Stephen Chapman: MATLAB for Engineers: Thompson Publications
Reference books
1. Steven C Chapra: Applied Numerical Methods with MATLAB: TATA McGRAW-HILL

	Strength of CO-PO Mapping					
CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO 1	3	1	3	3	3	2
CO 2	3	1	3	3	3	2
CO 3	3	1	3	3	3	2

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Assignment I- Analysis and Design of RCC element using Spreadsheet	**1**
2	Assignment II- Analysis and Design of element of steel structure using Spreadsheet	**1**
3	Assignment III- Analysis and Design of Structural elements by using Programming language	**2**
4	Assignment IV- Programming in Matlab	**2, 3**
5	Assignment V- Programming in Matlab	**2, 3**
Guidelines for Term work Assessment		
1.Assessment will be based on each unit. 2. Each assignment will be of 5 marks.		