JSPM University Pune

Faculty of Science and Technology

School of Civil and Environmental Sciences

NEP aligned Syllabus

for

M. Tech (Structural Engineering)

(Effective from AY: 2025-26)

JSPM University Pune

FACULTY OF SCIENCE & TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES

FIRST YEAR MASTER OF TECHNOLOGY
(STRUCTURAL ENGINEERING)

COURSE STRUCTURE (NEP 2020 Aligned)	
W. E. F	2024 - 2025
RELEASE DATE	01/07/2025
REVISION NO.	1.0 (NEP)

SEMESTER I (LEVEL 6.5)

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PSMC	230GMAM02_01	Advanced Numerical Methods	2	1	-	-	30	30	40	100	-	-	-	-	100	3
PCC	231GSEM01_01	Advanced Analysis of Structures	2	-	-	-	30	30	40	50	-	-	-	-	50	2
PCC	231GSEM02_01	Structural Dynamics	2	-	-	2	30	30	40	100	-	-	-	-	100	2.5
PCC	231GSEM03_01	Advanced Design of Reinforced Concrete Structures	3	-	-	-	30	30	40	100	-	-	-	-	100	3
MMC	-	Multidisciplinary Minor Course- I	1	-	2	-	-	-	-	-	50	50	50	50	100	2
SEC	230GTEM19_01	Geospatial Analysis	2	-	2	-	-	-	-	-	50	50	50	50	100	3
VSC (HSMC)	230IDCB01_01	Design Thinking and Creativity	1	-	-	2	-	-	-	-	-	-	50	50	50	1.5
AEC (HSMC)	231UENM01_01	Communicative English for Professionals	1	-	2	-	-	-	-	-	50	50	-	-	50	2
RMC	230IRMM01_01	Research Methodology	2	-	-	-	30	30	40	50	-	-	-	-	50	2
LC	230GSEM23_01	Structural Engineering Lab	-	-	2	-	-	-	-	-	50	50	-	-	50	1
TOTAL			16	1	8	4									**750**	**22**

L-Lecture **T-Tutorial** **P-Practical Session (Laboratory)** **EL-Experiential Learning**

Sem	Multidisciplinary Minor Course (MMC)	
I (MMC – I)	**Course Code**	230GRAM24_01
	Course Name	Sensors and Automation
II (MMC – II)	**Course Code**	230GETM16_02
	Course Name	IoT Basics and Applications

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: PSMC	**Course Title:** Advanced Numerical Methods	
Course Code: 230GMAM02_01	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 1 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

1. Engineering Mathematics

Course Objectives:

The course aims at

- This postgraduate course Develop a deep understanding of numerical methods for solving algebraic.
- Students will Learn numerical techniques for the integration of ordinary differential equations. Familiarize yourself with methods such as Euler, Adams, Runge-Kutta, and predictor-corrector procedures for solving differential equations.
- Explore the solution of partial difference equations using finite difference techniques. Understand the principles behind finite element methods for solving partial difference equations.

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

CO1: Apply numerical methods to find solutions of algebraic equations, demonstrating a deep understanding of iterative algorithms, convergence, and the Newton-Raphson procedure.

CO2: Solve polynomial and simultaneous linear equations, demonstrating mastery of these fundamental mathematical techniques.

CO3: Perform numerical integration, utilizing different numerical approximations.

CO4: Solve ordinary differential equations using Euler, Adams, Runge-Kutta, and predictor-corrector methods, demonstrating proficiency in solving complex problems.

CO5: Solve partial difference equations using finite difference techniques and finite element methods.

CO6: Perform curve fitting, interpolation, extrapolation and, predictions in real-world applications.

Course Contents

Unit I	**Numerical Solution of Equations**	**(8 Hours)**

Numerical solution of algebraic equations, Gauss elimination method, LU Decomposition Method, Iterative algorithms, Convergence, Newton Raphson procedure

Unit II	**Linear Equations**	**(7 Hours)**
Solutions of polynomial and simultaneous linear equations.		
Unit III	**Numerical Integration**	**(7 Hours)**
Numerical Integration, Euler-Maclaurin formula, Newton-Cotes formulae, Gaussian quadratures.		
Unit IV	**Differential Equations**	**(8 Hours)**
Numerical integration of ordinary differential equations: Methods of Euler, Adams, Runge-Kutta and predictor-corrector procedures.		
Unit V	**Partial Difference Equations**	**(8 Hours)**
Solution of partial difference equations: Finite difference techniques, Finite element methods		
Unit VI	**Curve Fitting and Interpolation**	**(7 Hours)**
Curve fitting; Interpolation and extrapolation methods for data analysis and modeling.		

Learning Resources

Text Books:

1. Kiusalaas,J.," *Applied Numerical Methods in Engineers with Python*", 5ed., Cambridge University Press, 2005.
2. Gerald,C.F. and Wheatley,P.O., "*Applied Numerical Analysis*", 6ed., Pearson Education,1999.
3. Suli & Mayers, "*An introduction to numerical analysis*", 4ed., Cambridge University Press, 2003.

Reference Books:

1. Chapra,S.C.and Canale,R.P., "*Numerical Methods for Engineers with Programming and Software Applications*", 3ed.,TataMcGraw Hill, New Delhi,1998

MOOC / NPTEL Courses:

1. Swayam course "*Applied Numerical Methods*", Prof. Malay K. Das, IIT Kanpur.

   Link of the Course: https://onlinecourses.nptel.ac.in/noc23_me135/preview

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F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: PCC	**Course Title:** Advanced Analysis of Structures	
Course Code: 231GSEM01_01	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: -

1. Mechanics of structures Structural analysis

Course Objectives:

- To provide students with a solid understanding of the fundamental principles of structural analysis and indeterminacy
- To enable students to analyze structures using both the stiffness method and the flexibility method
- To introduce students to advanced topics in structural engineering, such as plastic analysis of structures, suspension cables and bridges, and space structures

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

CO1: Classify different types of structures and determine the equilibrium of the structures
CO2: Analyze the beams and rigid frames using Stiffness Matrix Method
CO3: Analyze the beams and rigid frames using Flexibility Matrix Method
CO4: Perform Plastic analysis of Structures
CO5: Analyze suspension cables and suspension bridges
CO6: Understand the behaviour of space structures

Course Contents

Unit I	**Introduction**	**(5 Hours)**

Basic concepts of structural analysis, Classification of structures, Methods of analysis of skeletal structures, degrees of freedom–static & kinematic indeterminacy

Unit II	**Stiffness method**	**(5 Hours)**

Stiffness method - coordinate systems, transformation matrix, formation of stiffness matrices, analysis of continuous beams, and rigid jointed plane frames with redundancy limited to two.

Unit III	**Flexibility Method**	**(5 Hours)**

Flexibility method - Element Flexibility matrix–beam element– force transformation matrix – equilibrium–compatibility, application to continuous beams, and rigid jointed plane frames with redundancy limited to two.

Unit IV	Plastic analysis of structures	(5 Hours)
Plastic moment of resistance Plastic modulus - Shape factor - Load factor - Plastic hinge and mechanism - Plastic analysis of indeterminate beams - Upper and lower bound theorems		
Unit V	**Suspension cables and bridges**	**(5 Hours)**
Suspension cables – suspension bridges with two and three hinged stiffening girders		
Unit VI	**Tree and Graph**	**(5 Hours)**
Beams curved in plan, Analysis of plane trusses using method of tension coefficients		

Learning Resources

Text Books:

1. Pandit G.S and Gupta S.P, "*Structural Analysis – A Matrix Approach*", , Tata McGraw Hill Publishing Company Ltd., Second Edition.
2. T.H.G. Megson, "*Structural and Stress Analysis*, Butterworth-Heinemann, Fourth Edition)
3. Bhavikatti S.S., *"Structural Analysis-II"*, Vikas Publishing House, 5th Edition.

Reference Books:

1. Reddy C.S., "*Basic Structural Analysis*", Tata McGraw Hill Publishing Co, Third Edition.
2. R. C. Hibbler, "*Intermediate Structural Analysis*", Pearson Education Publishers, Third Edition.
3. Weaver and Gere "*Matrix Analysis of Framed Structures*", CBS Publication, Third Edition.
4. Kassimali, "*Matrix Analysis of Structures*", Brookes/Cole Publishing Company, Second Edition.

MOOC / NPTEL Courses:

1. NPTEL Course "Advanced Structural Analysis", Prof. Devedos Menon, IIT Madras.

Link of the Course: https://archive.nptel.ac.in/courses/105/106/105106050/

Additional Web Resources:

1. https://archive.nptel.ac.in/courses/105/105/105105109/#
2. https://archive.nptel.ac.in/courses/105/101/105101086/

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: PCC	**Course Title:** Structural Dynamics	
Course Code: 231GSEM02_01	**Teaching Scheme:** (Hrs/week)	**Examination Scheme:**
Credits: 2.5	**Lecture (L): 2** **Tutorial (T): 0** **Practical (P): 0** **Experiential Learning (EL): 2**	**Theory (TH): 100 Marks**

Prerequisite Courses, if any:

1.

Course Objective:

- To have an overall concept of dynamic characteristics of structures and their behaviour under different types of dynamic load.
- To familiarize students with the theories of vibration and different processes to analyze the dynamics of SDOF and MDOF systems.

Course Outcomes: At the end of course, Students will be able to

CO1: To understand the objectives of dynamic analysis
CO2: To know the dynamics of damped and undamped free vibrations SDOF system
CO3: To understand the dynamics of damped and undamped forced vibrations SDOF system.
CO4: To understand the dynamics of MDOF system.
CO5: To gather the understanding of methods of Practical Vibration Analysis of 2 DOF system.
CO6: To explain the Response Spectrum method.

Course Contents

Unit I	**Introduction to Dynamics**	**(4 Hrs)**
Introduction to Dynamics, Objectives of dynamic analysis, Types of prescribed dynamic loading, Characteristics of a dynamic problem, Methods of discretization: Lumped mass Procedure/Consistent mass procedure, D'Alembert's Principle.		
Unit II	**SDOF System: Free Vibrations**	**(5 Hrs)**
Single Degree Freedom Systems, Response of Un-damped and damped free vibrations of SDOF systems, Logarithmic decrement and applications. Displacement Meters,		
Unit III	**SDOF System: Forced Vibrations**	**(5 Hrs)**
Un-damped/Damped vibrations of SDOF systems subjected to Harmonic loading, non-periodic loading, Duhamel's integral, Resonant Response, and Vibration Isolation.		
Unit IV	**MDOF System**	**(7 Hrs)**

Multi Degree of Freedom Systems Formulation of Equations of Motion, Evaluation of Lumped Mass Matrix, Mode Shape Matrices, Orthogonality Conditions, Mode super position procedure for damped forced vibrations, Time History Analysis.		
Unit V	**Practical Vibration Analysis**	**(5 Hrs)**
Practical Vibration Analysis Stodola Method, Holtzer Method - Fundamental mode only, Lagrange's Equations of Motion, Application to simple un-damped problems of 2-DOF systems.		
Unit VI	**Dynamic Analysis**	**(4 Hrs)**
Analysis of dynamic response, Earthquake Resistant Design: Brief exposure to relevant IS Codes of Practice, Method of construction of Response Spectra.		

Learning Resources

Text Books:

1. 1. Paz, M., Structural Dynamics, CBS Publishers & Distributors, New Delhi, 1997
2. 2. Chopra, A. K., Dynamics of Structures, Prentice-Hall of India Pvt. Ltd., New Delhi, 2011.
3. 3. Craig, R.R., Structural Dynamics An Introduction to Computer Methods, John Wiley &Sons, New York, 1983.

Reference Books:

1. Clough And Penzien, Dynamics Of Structures, McGraw-Hill Education, third edition

MOOC / NPTEL Courses:

1. NPTEL Course “Structural Dynamics”, Prof. Pradipta Banerji, IIT Bombay
   Link of the Course: https://nptel.ac.in/courses/105101006

Additional Web Resources: **Additional Web Resources:**

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: PCC	**Course Title:** Advanced Design of Reinforced Concrete Structures	
Course Code: 231GSEM03_01	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: -

1.

Course Objectives:

- To have an overall concept dynamic characteristics of structures and their behaviour under different types of dynamic load.

Course Outcomes: At the end of course, Students will be able to

CO1: Explain the structural behaviour of flexural members
CO2: To study the design philosophies of shear wall.
CO3: To know the design procedure of deep beam.
CO4: To understand the design of Corbels.
CO5: To undertake problems on design of flat slabs.
CO6: To design the composite construction systems.

Course Contents

Unit I	**Introduction to RC Design**	**(5 Hrs)**
Properties and behaviour of concrete and steel – Behaviour and design of R.C. beams in flexure, shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.		
Unit II	**Design of Shear Walls**	**(5 Hours)**
Introduction, Reinforcements in wall, calculation of loads and eccentricity, Design of Shear Walls - Compression Field theory for shear design-code provisions		
Unit III	**Design of Deep Beams**	**(5 Hours)**
Introduction- IS Code Recommendations - Design of simply supported and continuous deep beams		
Unit IV	**Design of a Corbel**	**(Hrs)**
Design of Corbels - Introduction - IS Code Recommendations, Shear friction, Corbel dimensions, Design of a corbel.		

Unit V	Design of Flat Slab	(5 Hours)
Introduction Components and proportioning of flat slab elements IS Code recommendations, total design moment, distribution of moments in flat slabs, effect of pattern loading - shear in flat slabs		
Unit VI	**Composite Construction**	**(5 Hours)**
Introduction - Design principles of shear connectors IS Code Recommendations - Design of Slab Beam type of composite construction systems.		

Learning Resources

Text Books:

1. P.C. Varghese, Advanced Reinforced Concrete Design, 2nd Edition, PHI, 2012.
2. Dr. S.R. Kaye and Dr. V.L. Shah, 8th Edition Limit state Theory and Design of Reinforced Concrete, Standard Publishers, Pune, 2020.
3. N. K. Raju, R.N Pranesh, Reinforced concrete design, New age international Pvt. ltd.

Reference Books:

1. Park R., Reinforced Concrete structures and PaulayT., 1st Edition, John Wiley & Sons, 1995,
2. Hsu T. T. C and Mo Y. Ls, Unified Theory of Concrete Structures, 1St Edition, John Wiley & Sons, 2010.
3. S. Unnikrishnan Pillai & Menon, Reinforced Concrete Design, 4th Edition, Tata McGraw-Hill, 2021. IS-Codes: la
4. IS-456-2000/ SP-34, SP-16 and 15-875 -1987(Part I to IV)

MOOC / NPTEL Courses:

1. NPTEL Course “https://onlinecourses.nptel.ac.in/noc23_ce109/preview”, Prof. Sudhir Dr. S. Surya Prakash, IIT Hyderabad
   Link of the Course: https://archive.nptel.ac.in/courses/

Additional Web Resources: **Additional Web Resources:**

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: SEC	**Course Title**: Geospatial Analysis	
Course Code: 230GTEM19_01	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):**	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:

1. Basic Computer Knowledge
2. Remote Sensing basics

Course Objectives:

- To apply the concepts of Photogrammetry and its applications such as determination of heights of objects on terrain.
- To understand the basic concept of Remote Sensing and know about different types of satellite and sensors.
- To illustrate Energy interactions with atmosphere and with earth surface features, interpretation of satellite and top sheet maps.
- To understand different components of GIS and Learning about map projection and coordinate system.
- Develop knowledge on conversion of data from analogue to digital and working with GIS software.

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

CO1: Understand the concepts of Photogrammetry and compute the heights of objects.
CO2: Apply knowledge of GIS and understand the integration of Remote Sensing and GIS.
CO3: Understand the basic concept of GIS and its applications, know different types of data representation in GIS.
CO4: Understand and Develop models for GIS spatial Analysis and will be able to know what the questions that GIS can answer are.
CO5: Apply knowledge of GIS software and able to work with GIS software in various application fields.
CO6: Illustrate spatial and non-spatial data features in GIS and understand the map projections and coordinates systems

Course Contents

Unit I	**Introduction to GIS**	**(5 Hours)**

Basic concepts: Definition and history, Components of GIS, Recent trends and applications of GIS; Data structure and formats, Spatial data models – Raster and vector, Data base design- editing and topology creation in GIS, Linkage between spatial and non-spatial data, Data inputting in GIS. Rectification, Transformation Methods; Root Mean Square (RMS) Error.

Unit II	Data Types and Data Models	(5 Hours)
Data Types; Spatial Data; Non-Spatial Data, Data Input; Existing GIS Data, Metadata; Conversion of Existing Data, Creating New Data, Data Models; Vector Data Model; Raster Data Model; Integration and Comparison of Vector and Raster Data Models.		
Unit III	**Spatial Data Editing**	**(5 Hours)**
Types of Digitizing Errors, Causes for Digitizing Errors; Topological Editing and Non-topological Editing; Other Editing Operations; Editing Using Topological Rules.		
Unit IV	**Attribute Data and Data Exploration**	**(5 Hours)**
Attribute Data in GIS, Attribute Data Entry, Manipulation of Fields and Attribute Data, Data Exploration; Attribute Data Query, Raster Data Query, Map- Based Data Manipulation.		
Unit V	**Spatial Analysis**	**(5 Hours)**
Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector- Based and Raster- Based GIS Operation Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect, Geographic Visualization Data Classification, Map Comparison.		
Unit VI	**Geo Statistical Analysis Techniques**	**(5 Hours)**
Introduction to Spatial Interpolation: Control Points, Global Method- Trend surface analysis, regression model, local methods- Thiessen polygons, density estimation, Inverse Distance weighted Interpolation, Kriging- Ordinary Kriging and Universal Kriging, GIS and decision support system, Introduction to AHP, basic principle of AHP. Principal and components of multiple criteria decision making.		

Learning Resources

Text Books:

1. Jahne, B. “Digital Image Processing” New York: Springer-Verlag.
2. Lillsand, R.M. and R.W. Kiefer, “Remote Sensing and Image Interpretation”, New York, Wiley.

Reference Books:

6. Pratt, W.K., “Digital Image Processing” New York Wiley.
7. Jain, A.K., “Fundamentals of Digital Image Processing”, Englewood Cliffs, NJ, Prentice Hall.

MOOC / NPTEL Courses:

1. Link of the Course: https://archive.nptel.ac.in/courses/107/105/107105088/, IIT Kharagpur

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: VSC	**Course Title:** Design Thinking and Creativity	
Course Code: 230IDCB01_01	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 1.5	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 2	**Oral (OR):** 50 marks

Prerequisite Courses, if any: - NA

Course Objectives:

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

CO1: Describe the Design thinking principles of Human Centered approach to real life problem solving

CO2: Demonstrate through the project-oriented approach the basic theories and knowledge of design thinking and master the tools and principles of design thinking, and their application.

CO3: Experiment with design thinking principles to come up with innovative solutions to the problems, as new products, services, experiences, or new Business models.

CO4: Analysis of various applications of design thinking.

CO5: Determine the suitable design thinking approach to solve the problem.

CO6: Develop a low fidelity prototype of the alternative Solutions to the identified Problem

Course Contents

Unit I	Design Thinking Introduction	(2 Hours)

Introduction & definition of design thinking, Principles, the process, Innovation in design thinking, importance of design thinking method, the relationship between design thinking and innovation & entrepreneurship. Five step method of Design thinking (Empathize, Define, Ideate, Prototype, Test).
Class Activity: Students are asked to form groups. Classroom Project begins: Share ideas with team members, discuss about meaning of DT, it's importance in today's world.
Case: ABC Nightline- IDEO Shopping Cart, (the video can be shown in classroom for discussion.)

Unit II	Awareness of the five stages of design thinking, Empathize & Define	(3 Hours)

Stage 1 & 2: Empathize & Define
Introduction of the tools in the stage of empathy. Emphasize the skills and tactics of interviews. Understand the persona, Methods of collecting data from interviews. The empathy map.
Establishing the Problem statement using 5 Why's technique as a tool to understand the root cause.
(Ex.26/11 attack, rescue team not able to move with ambulance due to stagnation) & Emphasis on establishing the "Problem Statement" only for faculty ref.
Classroom Project: Each group will write the Problem Statement by using Stages of Empathy and technique of 5 Why's. Each group member will do the interview round for writing the problem statement. Take record of the interview process.

Unit III	Ideate	(3 Hours)
Stage 3, Ideate Process to Find and select ideas, The creative process and creative principles, Creativity techniques, Evaluation of ideas. Idea Generation Stage-Fine tuning process of ideas (every team member comes up with 1 idea and passes on to next person, each idea will be fine- tuned by each team member and ultimately matured ideas are established- round robin method) and selection of best three ideas by voting method. Classroom Project: Through the project, students will know how to propose the point of view (POV) statement based on the analyses of data from user research via the brainstorm and others. Students are asked to submit ideas as many as possible. Note in POV practice: please define the problem which each group is finally going to resolve. The practice process: unpack the interview data, select one interviewee as analysis target and solution. Make inferences to generate ideas and POV statement. Please remember: No solution in the POV statement. (For faculty ref.: YouTube links for DT examples -How design thinking is transforming lives in rural India - https://www.youtube.com/watch?v=EH9u1bHqwpc. Design Thinking in Netflix | | Case Studio - 04 - https://www.youtube.com/watch?v=8P8gspd_Bx8)		
Unit IV	**Prototype & Test**	**(4 Hours)**
Stage 4 and 5, Prototype & Test Prototype and test stage, Prototype model, The role of prototype and test in innovation and entrepreneurship. prototype and the way to test, visualization of ideas. Classroom project: groups design the prototype to show ideas about the innovative way to resolve the problem in the dormitory life. Concerning the test practice: Ask other group to visit your group and test your prototype, and then in turn.		
Unit V	**Understanding Business Viability**	**(1 Hours)**
Checking the Business viability of selected ideas derived in stage 3 using BXT model, Tools for the Design Journey, Pillars of Design thinking.		
Unit VI	**Presentation and closure**	**(2 Hours)**
The student groups will give the final presentation of the project they have done (Unit 1 to 5) and close the DT process.		

Learning Resources

Text Books:

1. Design Thinking Methodology Book Paperback, ArtBizTech, Emrah Yayici, 2016.
2. Design Thinking for Strategic Innovation, by Idris Mootee, CEO Idea Couture, Wiley 2014.

Reference Books:

1. How Design Thinking Transforms organizations and inspires Innovation, Tim Brown, Harper Collins Publishers Ltd.
2. Design Thinking for Strategic Innovation, Idris Motee, John Wiley & Sons Inc.
3. “SL Schensul, JJ Schensul, MD LeCompte”, (latest reprint) Essential Ethnographic Methods: Observations, Interviews, and Questionnaires: (Ethnographer's Toolkit), https://rowman.com/ISBN/9780759122017

4. Paddy Miller, Thomas Wedell-Wedellsborg, (2013), Innovation as Usual: How to Help Your People Bring Great Ideas to Life, HBR Press
5. Tim Brown, (2010), Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HBR Press
6. "SL Schensul, JJ Schensul, MD LeCompte", (latest reprint) Essential Ethnographic Methods: Observations, Interviews, and Questionnaires: 2 (Ethnographer's Toolkit), https://rowman.com/ISBN/9780759122017

MOOC / NPTEL Courses:
Additional Web Resources:

1. Design Thinking -A Primer, Prof Ashwini Mahalingam and Prof. Bala Ramadurai. IIT Madars.
   Link: https://onlinecourses.nptel.ac.in/noc22_mg32/preview

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: AEC	**Course Title:** Communicative English for Professionals	
Course Code: 230UENM01_01	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR): 50 Marks**

Prerequisite Courses, if any: - NA

Course Objectives:

- **Remember** the different aspects of communication.
- **Understand** basics of grammar, sentence construction and vocabulary to write and speak effectively.
- **Apply** appropriate modes of expressions in written and oral communication.
- **Analyze** the attitude and aptitude of the speaker in the professional sphere for effective listening skill.
- **Evaluate** the non-verbal clues of the speaker for effective communication.
- **Cultivate** students to create commendable personalities.

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

CO1: Understand and practice different types of communication.
CO2: Reflect on basic language skills-listening, speaking, reading, and writing and attempt tasks by using functional grammar and vocabulary effectively.
CO3: Reproduce their understanding of concepts/principles of business communication skills.
CO4: Build relationships, solve problems, ensure understanding, resolve conflicts, and improve accuracy.
CO5: Become more self-confident and develop a strong determination.
CO6: Build social skills with ease and comfort.

Course Contents

Unit I	Foundation of Communication	(3 Hours)
Importance and types of Communication, Types of communication: Verbal and Non- verbal, Channels of communication, Barriers to Effective Communication and ways to mitigate.		
Unit II	**Language Competency/Functional English**	**(3 Hours)**
Basic rules of Phonics, Parts of Speech, Sentence Constructions, Prefixes and Suffixes		
Unit III	**Business Communication at Workplace**	**(2 Hours)**

Types of business letter, Characteristics of good business letter, Letter Components and Layouts, Email Communication, memo		
Unit IV	**Mindful Listening**	**(2 Hours)**
The purpose and types of listening, Principles of effective listening, Ways to improve listening skills, Role of Active listening in professional interactions and conflict resolutions		
Unit V	**Art of Effective Verbal Interaction**	**(2 Hours)**
Identifying common fears and anxieties related to speaking, Techniques to build confidence and overcome stage fright, Voice modulation, pitch, and pace for engaging delivery, Impromptu Speaking		
Unit VI	**Effective Body Language**	**(3 Hours)**
Basic Principles of Body Language and Nonverbal Communication, Signs and Clusters, Kinesics & Proxemics, Gesture & Posture		

Learning Resources

Textbook:

1. Adair, John. *Effective Communication*. London: Pan Macmillan Ltd., 2003.

Reference Book:

1. Carnegie, Dale. The Quick and Easy Way to Effective Speaking. New York: Pocket Books, 1977.
2. Mitra, Barun. Personality Development & Soft Skills, New Delhi: Oxford Press, 2011

MOOC / NPTEL Course:

1. NPTEL Course "Developing Soft Skills and Personality" by Prof. T Ravichandran, IIT Kharagpur
Link of the Course**:** https://nptel.ac.in/courses/109104107

Additional Web Resources:

1.https://www.britishcouncil.in/english/online/resourceswebsites/moocshttps://www.dailywritingtips.com/

JSPM University Pune F.Y. M. Tech "Structural Engineering" Semester I		
Course Type: AEC	**Course Title:** Communicative English for Professionals	
Course Code: 230UENM01_01	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR): 50 Marks**
Prerequisite Courses, if any: - Nil		

List of Laboratory Experiments	
Group A	
1.	Phonics
2.	Parts of Speech
3.	Presentation Skills
4.	Tenses
5.	Verbal and Non-verbal Communication
Group B	
6.	Listening Skills
7.	Reading Skill
8.	Body Language
9.	Formal Writing
10.	Email Writing
Virtual LAB Links:	

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: RMC	**Course Title:** Research Methodology	
Course Code: 230IRMM01_01	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 marks

Prerequisite Courses, if any: -

Course Objectives:

- To develop a research orientation among the students and to acquaint them with fundamentals of research methodology, research process and research design
- To develop skills in effectively searching for relevant literature sources and familiarize with formulation of research hypotheses
- To establish an understanding of various data types, data collection methods, and the importance of research ethics and integrity.
- To acquaint students with the process of crafting research reports and thesis

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

CO1: Demonstrate Proficiency in Research Fundamentals
CO2: Identify and Frame Research Problems
CO3: Conduct Comprehensive Literature Reviews and Formulate Testable Hypotheses
CO4: Collect and Differentiate the Types of Research Data
CO5: Practice Ethical Research Conduct
CO6: Create Effective Scientific Papers Through the Application of Scientific Writing Principles

Course Contents

Unit I	**Introduction to Research**	**(5 Hours)**
Meaning and Definition of Research, Objectives of Research, Characteristics of Research Need of Research, Importance of Research, Types of Research		
Unit II	**Problem Identification & Formulation**	**(5 Hours)**
Research Process, Research design, Defining the Research Problem, Formulation of Research Problem, Errors in selecting Research Problem, Research Questions, Research Methods vs. Research Methodology		
Unit III	**Literature Review and Hypothesis**	**(5 Hours)**
Literature Review Concepts and Theories, Meaning of Hypothesis and Formulation of Hypothesis, Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis, Tests of Hypothesis		

Unit IV	Research Data	(5 Hours)
Sampling Design and Types and Techniques, Types of Data, Methods of Data Collection, Questionnaires, Observation Method and Interview Method, Case Study Method		
Unit V	**Ethics in Research**	**(5 Hours)**
Ethics in conduct of Research, Ethical challenges in Data Collection, Ethical issues in scientific Publication, Plagiarism and Self-Plagiarism, Cases of Scientific Misconduct		
Unit VI	**Scientific Writing**	**(5 Hours)**
Preparation of Title, Keywords and Methods Section, Preparation of Figures and Schematics, Citations and Referencing, Report writing and Presentation, Layout of a Research Paper, Research Journals and its Impact factor, Research Metrics.		

Learning Resources

Text Books:

1. Wayne Goddard, Stuart Melville, "*Research Methodology: An Introduction*", Juta, Lansdowne, Second Edition.
2. Ranjit Kumar "*Research Methodology*: A Step-by-Step Guide for Beginners", SAGE Publications Pvt. Ltd Fourth Edition.

Reference Books:

1. Nicholas Walliman, *"Research Methods: The Basics",* Routledge – Taylor and Francis Group, Third Edition.
2. Vinod Chandra, Anand, Hareendran "*Research Methodology*", Pearson 1st Edition
3. Dr. Prabhat Pandey, Dr. Meenu Mishra Pandey, "Research Methodology: Tools and Techniques", Bridge Center, 2015.
4. Alan Bryman & Emma Bell, "*Business Research Methods*", Oxford University Press, Third Edition.

MOOC / NPTEL Courses:

1. NPTEL Course "*Research Methodology*", Prof. Edamana Prasad, Prof. Prathap Haridoss, IIT Madras.
   Link of the Course: https://onlinecourses.nptel.ac.in/noc23_ge36/preview
2. NPTEL Course "*Research Methodology*", Prof. Soumitra Banerjee, IISER Kolkata.
   Link of the Course: https://archive.nptel.ac.in/courses/127/106/127106227/

Additional Web Resources:

1. https://www.coursera.org/learn/research-methods
2. https://www.coursera.org/specializations/data-collection
3. https://www.coursera.org/learn/introduction-to-academic-writing

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: LC	**Lab Course Title:** Structural Engineering lab	
Course Code: 230GSEM23_01	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 0 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks

Prerequisite Courses, if any: -

List of Laboratory Experiments	
Group A Test	
1.	Estimation of compressive strength of concrete using Rebound Hammer.
2.	Estimation of compressive strength of concrete using Rebound UPV.
3.	Modes of Vibration of Simply Supported Beam Under Flexure.
4.	Modes of Vibration of Simply Supported Square Plate.
Group B Test	
5.	Forced Excitation of Steel Beam Using Portable Shaker.
6.	Analysis of Simply supported beam using STAAD-Pro.
7.	Analysis of Continuous beam using STAAD-Pro.
8.	. Analysis of Cantilever beam using STAAD-Pro.
	Group C Test
9.	.
10.	Analysis of 3D Framed Structure using STAAD-Pro.
11.	Analysis of 3D Framed Structure using STAAD-Pro under Seismic Load

Virtual LAB Links:

1. Lab Name: NDT & Concrete Lab
   Link of the Virtual Lab: https://ts-nitk.vlabs.ac.in/

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: MMC	**Course Title:** Sensors & Automation	
Course Code: 230GRAM24_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:

1. Basic Electronics
2. Instrumentation & Control

Course Objectives:

- Study of means of measuring various physical variables using sensors.
- Study of various kinds of actuators.
- Introduce technologies related to the upcoming Industry 4.0 paradigm.
- To prepare the learner for a career in industrial automation.

Course Outcomes: On completion of the course, learner will be able to…

CO1: Identify sensor characteristics, calibration and error analysis
CO2: Understand how different physical variables are measured
CO3: Identify different types of actuators and their implementation
CO4: Understand Hydraulic and Pneumatic actuators
CO5: Explain scope and benefit of industry 4.0 technologies.
CO6: Plan, design and implement automation systems

Course Contents

Unit I	Instrumentation & Sensors characteristics	(3 Hours)

Instrumentation & Sensors: Significance of Sensor Measurements, Classification of sensors based on domain, technology and operation.
Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc.
Dynamic Characteristics: Sensor bandwidth and frequency response.
Signal conditioning: Amplifier, Conversion, Filtering, Impedance Buffering

Unit II	Measurements	(3 Hours)

Proximity and Distance Measurement: Limit Switch, Reed switch, Inductive, Capacitive, Hall Effect Sensors, Optical and Ultrasonic distance measurement.
Displacement Measurement: Transducers for displacement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder).
Measurement of Angular Velocity: Tachometers, Digital tachometers and Stroboscopic

Methods. MEMS 3 axis Gyroscope.

Acceleration Measurement: Theory of accelerometer and vibrometers, accelerometers, strain gauge based and piezoelectric accelerometers. MEMS 3 Axis Accelerometer.

Unit III	Electrical Actuating systems	(2 Hours)

Electrical Actuating systems:

DC motors: Review of DC motor, Modelling of DC motor behaviour, Servo Amplifier, DC motor drive. DC Servo Motors.

Stepper Motors: Characteristics of a Stepper motor, Classification of a Stepper motor, Principle of Operation, Step Angle, Electrical model of energized coil, Drive method, Stepper motor performance.

Unit IV	Pneumatic and Hydraulic actuating systems	(2 Hours)

Pneumatic and Hydraulic actuating systems: Components of pneumatic and hydraulic systems, pumps, compressor, filter, control valves, pressure regulation, relief valves, accumulator. Single Acting and Double acting cylinders, Hydraulic motors. Simple single actuator circuits. Harmonic drive, Comb drive.

Unit V	Industry 4.0 and Evolution of automation	(3 Hours)

Industry 4.0: Industrial Revolutions 1,2,3,4, Productivity in Manufacturing, how manufacturing changed at each IR, Work Study & motion study, Need and Types of Automation,

Evolution of automation: Automation hierarchy. Relentless increase in computational power (Moore's law), basket of technologies, which make up Industry 4.0. Reference Architecture Model of Industry 4.0 (RAMI)

Unit VI	Automation Circuits	(2 Hours)

Automation Circuits: Introductory Principles in Designing, Electrical and mechanical latch, Logical Design of Automation PLC and SCADA.

Case Studies: Data Acquisition & Control Systems in Process Plants like chemical, railways and defence applications

Communication: Communication protocols, Device Interfaces

Learning Resources

Text Books:

1. Clarence W Silva, "*Sensors and Actuators: Control System Instrumentation*", CRC Press USA.
2. Frank Lamb, "*Industrial Automation Hands-On*", McGraw Hill Education 2013.

Reference Books:

1. E.O. Doebelin, "*Measurement Systems (Applications and Design)*", McGraw Hill., 5th Ed.
2. A. Smaili and F. Mrad, "*Applied Mechatronics*", OXFORD university press.
3. Thomas Beckwith, N.Lewis Buck, "*Mechanical Engineering Measurement*", Roy Marangoninarosa Publishing House, Bombay
4. Kataria Sanjay *"Industrial Automation Solutions For Plc, Scada, Drive And Field Instruments: Easy To Learn Industrial Automation"*
5. Arshadeep Bagha , Vijay Madisetti "*Internet of Things A Hands-on Approach*", Universities Press 2018

MOOC / NPTEL Courses:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://nptel.ac.in/courses/112/107/112107242/
3. https://nptel.ac.in/courses/108105088
4. https://nptel.ac.in/courses/106105195

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester I

Course Type: MMC	**Course Title:** Sensors & Automation	
Course Code: 230GRAM24_01	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:

List of Laboratory Experiments (Minimum 10)

(Group A)

1	Characterization of Temperature Sensor (RTD).
2	Linear Conveyor Control System
3	Study of Two-Dimensional Position Control
4	Demonstration of Electrohydraulic Controls through Trainer Kit
5	Characterization of Linear Variable Differential Transformer (LVDT) (Virtual Lab) https://sl-coep.vlabs.ac.in/exp/characterize-temperature-sensor/

(Group B)

6	Demonstration of Electro pneumatic Controls through Trainer kit
7	Study of Rotary Encoder for Speed & angle measurement
8	Data acquisition system
9	Demonstration of Programmable Logic Controller (PLC) based Servo motor Controller
10	Characterization of Strain Gauges (virtual Lab) https://sl-coep.vlabs.ac.in/exp/strain-gauge-sensor/

Virtual LAB Links:

1. **Lab Name: COEP, Pune**
   https://sl-coep.vlabs.ac.in/exp/characterize-temperature-sensor
   https://sl-coep.vlabs.ac.in/exp/strain-gauge-sensor

JSPM University Pune

Faculty of Science and Technology

School of Civil and Environmental Sciences

NEP aligned Syllabus

for

M. Tech (Structural Engineering)

(Effective from AY: 2025-26)

	JSPM University Pune	COURSE STRUCTURE (NEP 2020 Aligned)	
	FACULTY OF SCIENCE & TECHNOLOGY	W. E. F	2024 - 2025
	SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES	RELEASE DATE	01/07/2025
	FIRST YEAR MASTER OF TECHNOLOGY (STRUCTURAL ENGINEERING)	REVISION NO.	1.0 (NEP)

SEMESTER II

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)	CONTINUOUS INSEMESTER EVALUATION (50 Marks)	END SEMESTER EXAMINATION (50 Marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PCC	230GSEM05_02	Finite Element Methods	2	1	-	-	30	30	40	100	-	-	-	-	100	3
PCC	230GSEM06_02	Earthquake Resistant Design of Structures	2	-	-	2	30	30	40	100	-	-	-	-	100	2.5
PCC	230GSEM07_02	Prestressed Concrete Structures	3	-	-	-	30	30	40	100	-	-	-	-	100	3
MMC	-	Multidisciplinary Minor Course- II	1	-	2	-	-	-	-	-	50	50	50	50	100	2
SEC	230GSEM19_02	Building Information Modelling	2	-	2	-	-	-	-	-	50	50	50	50	100	3
VSC (HSMC)	230IINB02_02	Innovation	1	-	-	2	-	-	-	-	-	-	50	50	50	1.5
AEC (HSMC)	231UENM02_02	Business Communication	1	-	2	-	-	-	-	-	50	50	-	-	50	2
RMC	230IRMM02_02	Research Design and Techniques	2	-	-	-	30	30	40	50	-	-	-	-	50	2
LC	230GSEM24_02	Structural Analysis lab	-	-	2	-	-	-	-	-	50	50	-	-	50	1
IITP/FP/ CEP	230GSEM25_02	Internship / Field Project / Community Engagement Programme	4 to 6 weeks				-	-	-	-	-	-	50	50	50	2
TOTAL			14	1	8	4									750	22

L-Lecture T-Tutorial P-Practical Session (Laboratory) EL-Experiential Learning

Note: A **Postgraduate Diploma** will be awarded if a student exits after first year.
For Exit at the end of first year the student must complete: (Total credits = 8)
a) An internship / OJT of 8 - 10 weeks (4 credits)
b) Additional Course 1 (4 credits) (Vocational Skill Course (VSC) / Skill Enhancement Course (SEC))

Sem	Multidisciplinary Minor Course (MMC)	
I (MMC – I)	**Course Code**	230GRAM24_01
	Course Name	Sensors and Automation
II (MMC – II)	**Course Code**	230GETM16_02
	Course Name	IoT Basics and Applications

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: PCC	**Course Title:** Finite Element Methods	
Course Code: 230GSEM05_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 2 **Tutorial (T):** 1 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 marks

Prerequisite Courses, if any:

1.
2.

Course Objective:

- To have an overall concept finite element modelling of structures.

Course Outcomes: At the end of course, Students will be able to

CO1: To Model the engineering problems mathematically
CO2: To Apply the Method of Weighted Residuals
CO3: To Translate FEA one dimensional formulation.
CO4: To Translate FEA one dimensional formulation.
CO5: To Translate FEA one dimensional formulation.
CO6: To Formulate Dynamic System using FEM.

Course Contents

Unit I	Introduction	(7 Hours)

History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.

Unit II	Method of Weighted Residuals	(8 Hours)

Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector **Method of Weighted Residuals**: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.

Unit III	Types of different Element	(8 Hours)

Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.

Unit IV	Plane stress problem in FEM	(7 Hours)

Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain, and Stress Computations.

Unit V	Finite Element Formulation for Three Dimensional Problems	(8 Hours)
Different types of three-dimensional elements: Derivation of shape function in three dimension, Examples of three-dimension problem		
Unit VI	**Finite Element Formulation of Dynamic System**	**(7 Hours)**
Dynamic problems and finite element solutions techniques, Free vibration problems of rod and beam, Lumped and consistent, mass matrix methods		

Learning Resources

Test Books:

1. Daryl L. Logan and Martin Logan, A First Course in The Finite Element Method, CL Engineering, 2010
2. An Introduction to the Finite Element Method, An Introduction to the Finite Element Method, McGraw Hill, 2017,
3. R.D. Cook, D. S. Malkus and M.E. Plesha, Concept and Application of Finite Element Analysis, John Wiley & Sons Inc, 2001

Reference Books:

1. T. J. R. Hughes, The Finite Element Method – Linear Static and Dynamic Finite Element Analysis, Dover Publications Inc., 2003
2. Seshu. P. "Textbook of Finite Element Analysis" Prentice Hall of India, 2003
3. S.S. Rao, "The Finite Element Method in Engineering "Butter worth Heinemann, 2001.

MOOC / NPTEL Courses:

1. NPTEL Course "*Finite Element Method*", Prof. Biswanath Banerjee, Prof. Amit Shaw, IIT Kharagpur

   Link of the Course: https://youtu.be/4VMoZPZVhDM

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: PCC	**Course Title:** Earthquake Resistant Design of Structures	
Course Code: 230GSEM06_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2.5	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 2	**Theory (TH):** 100 marks

Prerequisite Courses, if any:

1.
2.

Course Objective:

Course Outcomes: At the end of course, Students will be able

CO1: To explain the basics of seismic design
CO2: To study the equivalent static load
CO3: To know the strength and stiffness.
CO4: To understand Requirements Seismic Design.
CO5: To undertake significant Box Action and Bands.
CO6: To understand seismic resistant design of RC building.

Course Contents

Unit I	Introduction seismic design	(6 Hours)

Reviews of latest I.S: 1893: 2016 (Part 1) provisions for buildings, Design Acceleration spectrum – Horizontal seismic coefficient – Seismic zones of India – Importance factor – Response reduction factor – Design lateral force – Design imposed loads for Earthquake force calculation –Seismic weight

Unit II	Equivalent Static Method	(6 Hours)

Analysis by Equivalent Static Method and Dynamic Method (Response Spectrum Method) – Storey drift limitation

Unit III	Strength and Stiffness	(6 Hours)

Strength and Stiffness – Ductility – Definition – Ductility Relationships – Choice of construction Materials – Provision for special Confining reinforcement - Design Earthquake Loads – Basic Load Combinations – Permissible Stresses.

Unit IV	Seismic Design Requirements	(6 Hours)

Seismic Design Requirements and Methods. RC Buildings – IS Code provision for Vertical Irregularities – Mass Irregularity Torsional Irregularity- Design Lateral Force, Base Shear Evaluation – Lateral Distribution of Base Shear, Behaviour of Unreinforced and Reinforced Masonry Walls

Unit V	Box Action and Bands	(6 Hours)

Box Action and Bands– Behaviour of infill Walls - Non-Structural Elements – Failure Mechanism of Nonstructural Elements– Effects of Nonstructural Elements on Structural System – Analysis – Prevention of Damage to Non-structural Elements – Isolation of Non- Structures.		
Unit VI	**Considerations in Seismic Design**	**(8 Hours)**
Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behavior of beams, columns and beam-column joints in RC buildings during earthquakes		

Learning Resources

Textbooks:

1 Pankaj Agarwal, Manish Shrikhande, *Earthquake Resistant Design of Structures*, PHI Publisher, January 2006.
2. S.K. Duggal, Earthquake Resistant Design Of Structures, Oxford Publisher, September 2013.
3. Dr. Vinod Hosur, Earthquake-Resistant Design of Building Structures, Wiley, January 2012.

References:

1. T. Paulay and M.J.N., Priestly, John Wiley & Sons, *Seismic Design of Reinforced Concrete and Masonry Building*, 1992.
2. AnandS. Arya, Masonry and Timber structures including earthquake Resistant Design, 2006
3. IS-456-2000, IS-1893:2016, SP-34, SP-16 and 15-875 -1987(Part I to IV)

MOOC / NPTEL Courses:

1. NPTEL Course, "*Seismic Analysis of Structures",* Dr. Ashok Gupta, Prof. T. K. Dutta, IIT Delhi

Link of the Course: "https://archive.nptel.ac.in/courses/105/102/105102016/"

Additional Web Resources:

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: PCC	**Course Title:** Prestressed Concrete Structures	
Course Code: 230GSEM07_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 marks

Prerequisite Courses, if any:

1. Design of Reinforced Concrete Structures

Course Objective:

- To develop an understanding of the philosophy of design of prestressed concrete
- To be able to design indeterminate prestressed concrete structure
- To design the prestressed concrete bridge and composite sections

Course Outcomes: At the end of course, Students will be able

CO1: To explain the principle and methods of prestressing
CO2: To analyse the prestressed concrete sections
CO3: To evaluate the deflection of prestressed concrete members and losses of prestress
CO4: To determine the transfer of prestress in pretensioned and post tensioned members
CO5: To analyse and design the beams for flexure and shear
CO6: To analyze and design the prestressed composite beams

Course Contents

Unit I	Principles of Prestressing	(6 Hours)

General principles of prestressing, Classification and types of prestressing- Materials- high strength concrete and high tensile steel - their characteristics.
Pre tensioning and post tensioning methods and systems of prestressing - Hoyer system, Magnet Blaten system, Freyssinet system and Gifford- Udall System- Lee McCall system.

Unit II	Analysis of sections	(8 Hours)

Analysis of prestressed concrete sections – Resultant stresses at a section – strength concept – pressure line concept – concept of load balancing

Unit III	Deflection and Losses of Prestress	(7 Hours)

Deflections: Importance of control of deflections- Factors influencing deflections short term deflections of uncracked beams - prediction of long-time deflections - BIS code requirements
Loss of prestress in pretensioned and post-tensioned members duo to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional losses.

Unit IV	Transfer of Prestress	(8 Hours)

Transfer of Prestress in Pretensioned Members; Transmission of Prestressing force by bond – Transmission length – Flexural bond stresses, IS code provisions, Anchorage zone stresses in post tensioned members stress distribution in End block - Analysis by Guyon, Magnet, Rowe's methods — Anchorage zone reinforcement- BIS Provisions		
Unit V	**Design of sections**	**(8Hours)**
Analysis of sections for flexure- beams prestressed with straight, concentric, eccentric, tendons- stress diagrams- Elastic design of PSC beams of rectangular and I section- Kern line – Cable profile and cable layout. Shear: General Considerations- Design of shear reinforcements		
Unit VI	**Composite Beams**	**(8 Hours)**
Composite Beams: Different Types- Propped and Unpropped- stress distribution- Differential shrinkage- Analysis of composite beams- general design considerations.		

Learning Resources

Textbooks:

1 Arthur H. Nilson, "*Design of Prestressed Concrete*", John Wiley and Sons Inc, Second Edition.
2. Krishna Raju, "*Prestressed Concrete*", Tata McGraw Hill Publishing Co., Sixth Edition.

Reference Books:

1. Lin T.Y. and Burns. H "*Design of Prestressed Concrete Structures*", John Wiley and Sons Inc, Third Edition.
2. Rajagopalan. N, "*Prestressed Concrete*", Narosa Publications, Second edition.
3. Sinha N.C. and Roy. S.K, "*Fundamentals of Prestressed Concrete*", S.Chand and Co., Std. Edition.
4. IS1343:2012, Code of Practice for Prestressed Concrete

MOOC / NPTEL Courses:

1. NPTEL Course "Prestressed Concrete Structures" Prof. Dr. Amlan Kumar Sengupta, IIT Madras

   Link of the Course: https://archive.nptel.ac.in/courses/105/106/105106118/

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: SEC	**Course Title:** Building Information Modelling	
Course Code: 230GSEM19_02	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:

1. Basic AutoCAD

Course Objectives:

- Familiarize students with the basic principles of Building Information Modeling (BIM) and the BIM cycle.
- Develop the skills to draw and modify fundamental building elements such as walls, windows, doors, and floors.
- Enable students to utilize advanced modification tools for efficient design adjustments.
- Provide in-depth knowledge of annotations, dimensions, and openings in architectural designs.
- Introduce students to visualization and rendering techniques for both interior and exterior.
- Guide students in developing a complete architectural project using all the learned tools and commands.

Course Outcomes: On completion of the course, learner will be able to…

CO1: Demonstrate proficiency in navigating the user interface, creating building elements, defining project units, and understanding file types within the BIM context.
CO2: Create detailed building plans, manipulate wall structures, and efficiently use commands for elements like windows, doors, and roofs.
CO3: Demonstrate proficiency in using tools like array, mirror, split, and align, facilitating precise modifications and enhancements in architectural designs.
CO4: Create and manage annotations effectively, including dimensions, and various types of openings in walls.
CO5: Create realistic images.
CO6: Demonstrate comprehensive knowledge and application of Revit Architecture software

Course Contents		
Unit I	**Introduction to BIM and Building commands**	**(6 Hours)**
Introduction to BIM: Explaining basics about the (BIM) cycle and the basic information, Exploring User Interface, Building Elements, Project Units, Visual Styles, File types Creating Levels & Level Family, Grid creation, modifications for level and grid. **Building Command:** Draw walls - Location line, draw wall shapes Drawing a plan as per Dimension Creating wall Structure Modify wall- Split Region, Sweep and Reveals Walls shapes and Openings Draw Windows & Doors, Family and edit type Create Floor & Floor Properties, Slab Edges, Place Components-Furniture Roof-by Footprint, by Extrusion, soffit, fascia, gutter Join/Unjoin Roof.		
Unit II	**Building architectural drawing**	**(5 Hours)**
Creating Curtain Wall, Curtain Grid, Mullions, Adding Curtain Door Panel, Embedded walls Practice with project. Dimensions, Temporary Dimensions, Dimension settings by edit type Permanent Dimensions, creating ceiling, Opening-wall, face and vertical opening, Shaft and Dormer.		
Unit III	**Modify commands & View**	**(6 Hours)**
Modify Tools: Join and cut geometry. Move, Copy, Paste, Rotate, Mirror, Array, Scale, Split Element, Trim, Align, Offset, Delete, Match Type, Tape Measure, filter, paint, match properties, keyboard shortcuts for all. **View:** Elevation view, Section view,3D views, view range, section box, visibility graphics hatching Area, Colour Schemes, Keynotes, Text, Model text, Tag, Callout Views, Drafting Views.		
Unit IV	**Circulation, Massing and Site**	**(5 Hours)**
Circulation: Stairs-Creating Stairs, creating stair by Sketching Runs. Creating stair by sketching Boundary and Riser, Spiral Staircase. Annotations for all related tools. Ramp, Railings and Rail Family, Modifying Rail Structure, Custom baluster, Staircase joints. Complete one project using all tools. Massing and Site: Create Mass Family using forms, Introduction Extrusion, Loft, Sweep blend, sweep Creating Building Elements from Mass Instance, Model-in-place, Mass Floors, creating wall, Floors, Roof and curtain system, Building pad, Graded Region, Parking, Topo surface Components, sub region, split surface, contour labels.		
Unit V	**Sheet Composition and Rendering**	**(5 Hours)**
Sheet Composition: Schedule/Quantities Material Take Off Legend Creation Sheets-Title Blocks, Views on sheet, Print settings. **Rendering and Walkthrough:** Lights-Adding Light Fixtures, Exterior Lighting-Solar Studies, sun setting, Camera and Walkthrough, Decal images, Exporting Walkthrough, Rendering, settings, customization, adjust exposure, Create realistic images for exterior and interior.		
Unit VI	**Design and Insert Option and Family creation**	**(3 Hours)**
Design option, Export to CAD format Family Creation- Door, Window, Project of interior view		

Learning Resources

Textbooks:

1. ASCENT, "*Autodesk Revit 2024 Architecture Fundamental*", SDC Publication.
2. Daniel John Stine AIA, "*Interior Design Using Autodesk Revit 2014*", SDC Publication.

Reference Books:

1. Autodesk, "Autodesk Revit User Manual", Autodesk

MOOC / NPTEL Courses:

1. https://nptel.ac.in/courses/112102101
2. https://www.youtube.com/playlist?list=PLMtzJAOD3B7YpZpVB17IFAFQG6Nqij- mY

JSPM University Pune F.Y. M. Tech "Structural Engineering" Semester II		
Course Type: SEC	**Course Title:** Building Information Modelling	
Course Code: 230GSEM19_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 marks **Oral (OR):** 50 marks
Prerequisite Courses, if any: -		

List of Laboratory Experiments	
Group A	
1.	Hands on practice on Revit Architecture user interface
2.	Practicing for creating walls, doors, and windows
3.	Creating curtain walls and opening in the walls
4.	Creating floors and roofs.
5.	Modifying objects
Group B	
6.	Creating dormer windows and stairs.
7.	Hands on practice on View and Area command
8.	Creating mass family
9.	Sheet compositions
Group C	
10.	Rendering and Walkthrough

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type:	**Course Title:** Innovation	
Course Code: 230IINB02_02	**Teaching Scheme:** (Hours. /Week)	**Examination Scheme:**
Credits: 1.5	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 2	**Oral (OR):** 50 Marks

Prerequisite Courses, if any: -

Course Objectives:

- To understand the concept of innovation and creativity
- To familiarize with the tools for innovation
- To understand fundamentals of innovation management
- To get overview of real-world implementation of innovation and creativity

Course Outcomes: On completion of the course, learner will be able to…

CO1: apply the concepts of creativity and innovation in all walks of life.
CO2: inculcate and incorporate individual creativity and innovative skill set at conceptual, product design and management level.
CO3: solve real time problems with enhanced ability in respective sectors of work for increased productivity and improved organizational behaviour.
CO4: perform with improved skill set in entrepreneurship and start up ecosystem.
CO5: to find solutions to social, corporate and personal problems with de novo approach.

Course Contents

Unit I	**Innovation & Creativity**	**(3Hours)**

Innovation: Meaning, Concept, Characteristics, Importance, Principles of Innovation, Process of Innovation.
Creativity: Meaning, Concept, Importance, Creativity Process, Components of creative performance, Hurdles to Creativity

Unit II	**Tools for Innovation**	**(5Hours)**

Creative Thinking: Traditional V/S Creative Thinking,
Individual Creativity Techniques: Meditation, Self-Awareness, & Creative Focus **Group Creative Techniques:** Brainstorming, Off The Wall Thinking &Thinking Hats Method.
Dimensions of Innovation:
Innovation Eco-system in India and abroad, Social Innovation, Grass root Innovation, Frugal Innovation, Global Innovation- Global Innovation Index framework, GII, Case studies in India and abroad.

Unit III	Innovation Management	(3Hours)
Concept, Scope, Characteristics, Evolution of Innovation Management, Significance, Factors Influencing Innovation, Commercialization of Innovation, Innovation and Start up ecosystem		
Unit IV	**Areas of Innovation**	**(2Hours)**
Innovation in Entrepreneurship, Product innovation, Process Innovation, Social Innovation, Case studies highlighting types, implementation imperatives and sector specific impact.		
Unit V	**Group innovation study**	**(1Hours)**
Each student group will prepare a case study on one innovation topic either from their area of work or through participation in the exposition, symposia, workshop of any relevant forum. The project report will be submitted for the study.		
Unit VI	**Presentation and Closure**	**(1Hours)**
The student group will give the presentation of the project in the chosen area. The report will highlight the process of exploring executing and exploiting the innovation. It will also mention methodology to manage the innovation.		

Learning Resources

Text Books:

1. Wagner, Tony. Creating Innovators: The Making of Young People Who Will Change the World. New York: Scribner, 2012.
2. "Managing Creativity and Innovation" Harvard Business School Press

Reference Books:

1. "Organizational Innovation", SAGE Publication, London, 2001.
2. "Jugaad Innovations, Navi Radjou and Jaideep Prabhu, Random House India
3. "Kelley, Tom, Jonathan Littman, and Tom Peters. The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm. New York: Doubleday, 2001.
4. "Innovation Management & New Product Development", Paul Trott, published by Pitman, 2000.

MOOC / NPTEL Courses:

1. NPTEL Course "*Innovation, Business Models and Entrepreneurship",* Prof Rajat Agrawal, Prof Vinay Sharma, IIT Roorkee.

   Link of the Course: https://onlinecourses.nptel.ac.in/noc23_mg116/preview

Additional Web Resources: https://youtu.be/FXJUDyqobbM
https://youtu.be/FF_38_ZuRbQ
https://youtu.be/33JjV_NDbpY
https://youtu.be/DNUwZctwwhw
https://youtu.be/_PC1qbAhKz0
https://youtu.be/wbFVNBNl7Bk
https://youtu.be/kfpERveB8kM
https://youtu.be/Y6R9ps2E1oM
https://youtu.be/66N5SM73AEc
https://youtu.be/1YLtkc6U3Rs

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: AEC	**Course Title:** Business Communication	
Course Code: 230UENM02_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 Marks

Prerequisite Courses, if any: Nil

Course Objectives:

- Remember the theoretical basics of Communication.
- Understand skills required for efficient interpersonal communication and leadership abilities.
- Apply Presentation Techniques in the Professional Environment.
- Analyze trends in the respective market to accommodate accordingly.
- Evaluate the skills related to production & presentation of messages in multiple formats.
- Create placement ready personalities.

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

CO1: Apply Verbal and Non-Verbal Communication Techniques in the Professional Environment

CO2: write impressive official correspondence and learn to make and give effective presentations in a professional environment.

CO 3: Write an impressive resume and face the interview confidently.

CO 4: Present themselves well in front of large audience on a variety of situations related to group communication and presentation in a relevant scenario.

CO5: Socialize with ease and comfort.

CO6: Develop Corporate Communication Skills

Course Contents

Unit I	**Employment Communication**	**(2 Hours)**

Introduction and objectives of Report Writing, Types of Business Reports-Informational Reports, Analytical Report, Research Report, Progress Report, Explanatory Report, Structure of Reports-Title page, table of content, summary, the main body, conclusion, and recommendations, Writing Abstracts and Summaries

Unit II	Resume Writing	(2 Hours)
Introduction to Resume Writing- Concept and Details, Types of Resume Writing- chronological and functional, Key components of effective Resume Writing, Structure and contents of Cover Letter		
Unit III	**Interview Skills / Techniques**	**(3 Hours)**
Interview Skills / Techniques – Concept and Process, Peer Interview/Mock Interview- Pre- interview planning and performance, Opening Strategies and Answering Strategies, Interview through tele and video- conferencing		
Unit IV	**Group Discussion**	**(3 Hours)**
Group Discussion – Concept and important points, Roles and Phases in Structured Group Discussion, Expectations of the Panel, Do's and Don'ts in Group Discussion		
Unit V	**Presentation Skills**	**(2 Hours)**
Elements of Presentation- Content, Organization, Delivery, Design of Presentation- Typography, colour, layout, images and animation, Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs, Written Presentations through Posters/Projects/Reports/ E-mails/Assignments		
Unit VI	**Essential Soft Skills**	**(3 Hours)**
Soft Skills development- Grooming Etiquettes and Manners, Stress and Conflict Management- Coping styles and symptoms, Time Management- Pomodoro Technique, Pareto Technique, Leadership Skills- Definition, Strategies, and Styles		

Learning Resources

Textbooks:

1. Bovee, Courtland L, John V. Thill & Barbara E. Schatzman. *Business Communication Today*: Tenth Edition. New Jersey: Prentice Hall, 2010.

Reference Books:

1. Collins, Patrick. *Speak with Power and Confidence*. New York: Sterling, 2009.
2. Barun, Mitra. Personality Development and Soft Skills, Barun K Mitra, Oxford Press, 2011.

MOOC / NPTEL Courses:

1. NPTEL Course "Soft skill Development" Prof. Priyadarshi Patnayak, Prof. V.N, Giri, Prof. D. Suar, IIT Kharagpur

Link of the course: https://youtu.be/Af9RoDvhTLE?si=cqQim2DX2Cepi0eX

Additional Web Resources:

http://www.englishdaily626.com/c-errors.php

https://www.stressdirections.com/personal/about_stress/stress_statistics.html

JSPM University Pune F.Y. M. Tech "Structural Engineering" Semester II		
Course Type: AEC	**Course Title:** Business Communication	
Course Code: 230UENM02_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical (PR):** 50 Marks
Prerequisite Courses, if any: -		

List of Laboratory Experiments	
Group A	
1.	Report Writing
2.	Resume Writing
3.	Interview technique
4.	Group Discussion
5.	Presentation Skills
Group B	
6.	Soft Skills: Grooming, Etiquettes and Manners
7.	Stress Management
8.	Time Management
9.	Leadership Skill
10.	PowerPoint Presentation

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: RMC	**Course Title:** Research Design and Techniques	
Course Code: 230IRMM02_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks

Prerequisite Courses, if any: -

Course Objectives:

- To develop the ability to create visual representations of data using appropriate tools
- To equip with various statistical techniques to draw meaningful conclusions from data
- To enable the students with the principles of experimental design, the formulation and execution of experiments
- To enable students to comprehend the concept of Analysis of Variance, and different types of ANOVA
- To develop proficiency in selecting and applying appropriate measures of association
- To acquaint students with the process of crafting research proposals

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

CO1: Demonstrate Proficiency in Data Visualization Techniques
CO2: Perform data analysis using statistical methods
CO3: Apply of Experimental Design Principles in various research contexts
CO4: Interpret research data using Analysis of Variance (ANOVA)
CO5: Demonstrate Proficiency in Measuring Associations
CO6: Develop Comprehensive Research Proposal

Course Contents

Unit I	Data Visualization	5 Hours
Data preparation process, data presentation, data visualization techniques, effective communication of complex findings		
Unit II	**Data Analysis**	**5 Hours**
Basic statistical concepts, measure of central tendency and variation, univariate statistics, sampling distribution, hypothesis testing		

Unit III	Design of Experiments	5 Hours
Basics of experimental design, principles of randomization, factorial experiments, fractional factorial designs, Design of Experiments (DOE)		
Unit IV	**ANOVA**	**5 Hours**
Introduction to ANOVA, One-way ANOVA, Two – way ANOVA, Analysis of Covariance (ANCOVA)		
Unit V	**Measures of Association**	**5 Hours**
Simple regression, Multiple Regression, Chi square tests, Equality of proportion test		
Unit VI	**Research Proposal Development**	**5 Hours**
Importance of research proposals in academic and professional contexts, Components of a research proposal, creating a realistic research timeline, Submitting the research proposal for funding or approval, Research proposal drafts and peer reviews		

Learning Resources

Text Books:

4. Wayne Goddard, Stuart Melville, "*Research Methodology: An Introduction*", Juta, Lansdowne, Second Edition.
5. Ranjit Kumar "*Research Methodology*: A Step-by-Step Guide for Beginners", SAGE Publications Pvt. Ltd Fourth Edition.
6. Dr. C. R. Kothari, "*Research Methodology: Methods and Trends*", New Age International (P) Limited, Publishers, Second Edition.

Reference Books:

1. Nicholas Walliman, *"Research Methods: The Basics",* Routledge – Taylor and Francis Group, Third Edition.
2. Vinod Chandra, Anand, Hareendran "Research Methodology", Pearson 1st Edition
3. Dr. Prabhat Pandey, Dr. Meenu Mishra Pandey, "Research Methodology: Tools and Techniques", Bridge Center, 2015.
4. Alan Bryman & Emma Bell, "*Business Research Methods*", Oxford University Press, Third Edition.

MOOC / NPTEL Courses:

1. "*Research Methodology*", Prof. Edamana Prasad, Prof. Prathap Haridoss, IIT Madras.

   Link of the Course: https://onlinecourses.nptel.ac.in/noc23_ge36/preview

2. "*Research Methodology*", Prof. Soumitra Banerjee, IISER Kolkata.

   Link of the Course: https://archive.nptel.ac.in/courses/127/106/127106227/

Additional Web Resources:

1. https://www.coursera.org/specializations/data-collection
2. https://www.coursera.org/learn/anova-and-experimental-design
3. https://www.coursera.org/learn/research-proposal-initiating-research

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: LC	**Lab Course Title:** Structural Analysis Lab	
Course Code: 230GSEM24_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 0 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):** 0	**Practical:** 50 marks

Prerequisite Courses, if any: -

List of Laboratory Experiments

	Group A Test
1.	Introduction to ETABS software for structural analysis and design.
2.	Introduction to SAP2000 software for structural analysis and design.
3.	Design of a 3D framed building with infill wall using ETABS.
4.	Design and analyze of a multi-storied building using Linear dynamic (Response spectrum) method using ETABS.
	Group B Test
5.	Design and analyze of a multi-storied building using Non-linear static (Pushover) method using ETABS.
6.	Design and analyze of a multi-storied building using Non-linear dynamic (Time-history) method using ETABS.
7.	Design and analyze of a multi-storied building using Linear dynamic (Response spectrum) method using SAP2000.
8.	Design and analyze of a multi-storied building using Non-linear static (Pushover) method using SAP2000.
	Group C Test
9.	Design and analyze of a multi-storied building using Non-linear dynamic (Time-history) method using SAP2000.
10.	Plot the response of a multi-storied building in excel.

Virtual LAB Links:

1. **Lab Name: Structural Analysis Lab**
   Link of the Virtual Lab: https://www.vlab.co.in/broad-area-civil-engineering

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: IITP / FP/CEP	**Lab Course Title:** Internship / Field Projects/ Community Engagement project	
Course Code: 230GSEM25_02	**Teaching Scheme:** (Hours./Week)	**Examination Scheme:**
Credits: 2	**Duration:** 04 to 06 Weeks	**Oral (OR):** 50 Marks

Prerequisite Courses, if any: -

Objectives:

- To expose students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.
- To provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training.
- To providing practical experience in a field or discipline

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

CO1: Develop professional competence through internship.
CO2: Apply academic knowledge in a personal and professional environment.
CO3: Build the professional network and expose students to future employees.
CO4: Apply professional and societal ethics in their day-to-day life.
CO5: Become a responsible professional having social, economic and administrative considerations.
CO6: Decide own career goals and personal aspirations.

Duration and Evaluation:

- Internship to be completed after every even semester (2, 4 and 6) and before commencement of next odd semester (03, 05 and 07).
- Internship should be at least 4 to 6 weeks and it is to be assessed immediately after completion.

Framework of Internship/ Field Project / Community Engagement Project:

- During the vacation after even semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Field Project / Community Engagement Project
- Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.
- Every student is required to prepare a file containing documentary proofs of the activities done by him.
- The evaluation of these activities will be done by Programme Coordinator/ Project Head / faculty / TPO/ mentor or Industry Supervisor.

Internship Guidelines:

Step 1: The department will issue a request Letter/ Email to the respective industry/ firm/ NGO/ organization to allot various slots of 4-6 weeks as internship**/** Field Project / Community Engagement Project periods for the students.

Step 2: Industry will confirm the training slots allocated for internships via Confirmation Letter/ Email.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training/ Field Project / Community Engagement Project at the concerned Industry / Organization. In- between Faculty Member(s) can evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department.

Step 5: Students will submit training reports after completion of internship.

Step 6: Training Certificate to be obtained from industry / Organization.

Internal Reporting Guidelines for students:

- Every intern should send weekly reports to their internal guide without fail. It is mandatory for the intern to send weekly reports to their respective guides on a regular basis.
- Interns should have at least fortnightly verbal communication with the internal guide without fail.
- In cases where in the company wants to secure their confidential information in the project / internship report, the internal guide should duly co-ordinate with the respective mentor/reporting manager on the method of reporting to assure that no information will be leaked outside and is purely for academic purposes.

Internship Diary / Internship Workbook:

- Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining a diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary an account of the observations, impressions, information gathered, and suggestions given, if any.
- The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working.
- Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.

Internship Diary / workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries.
- Adequacy & quality of information recorded
- Data recorded.
- Thought process and recording techniques used.
- Organization of the information.

Internship Work Evaluation:

- Every student is required to prepare and maintain documentary proofs of the activities done by him / her as internship diary or as workbook.
- The evaluation of these activities will be done by Programme Coordinator/ Project Head / faculty / TPO/ mentor or Industry Supervisor based on- overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Evaluation-Seminar presentation / Oral Examination at the institute:

The student will present a seminar based on his training report, before an expert committee constituted by the concerned department as per norms.
The evaluation will be based on the following criteria:

- Depth of knowledge and skills Communication & Presentation Skills.
- Team Work
- Creativity
- Planning & Organizational skills
- Adaptability and Analytical Skills
- Attitude & behaviour at work.
- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Log book
- Student's Feedback from External Internship Supervisor

- **Internship Report:**
- The report shall be presented covering following recommended fields but limited to:
- Title/Cover Page
- Internship completion certificate.
- Internship Place Details- Company background-organization and activities/Scope and
- object of the study / personal observation.
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- List of reference (Library books, magazines and other sources)

Feedback from internship supervisor (External & Internal):

Post internship, faculty coordinator should collect feedback about student with following recommended parameters:

- Technical knowledge
- Discipline
- Punctuality
- Commitment
- Willingness to do the work
- Communication skill
- Individual work
- Team work
- Leadership

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: MMC	**Course Title**: IOT Basics and Applications	
Course Code: 230GETM16_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):**	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any:

1. Basic Electronics
2. Basic Electrical engineering

Course Objectives:

To provide students with

- The knowledge and understanding of Internet of Things
- Provide a strong foundation of fundamentals of Internet of Things and need of IoT Security
- Get acquainted with various communication protocols of Internet of Things
- Detailed understanding of present scope of Internet of Things with case studies

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

CO1: Understand various terms related to IOT.
CO2: Understand the working of IOT devices.
CO3: Identify different types of Sensors and actuators for IOT.
CO4: Understand working of sensors and actuators
CO5: Understand the concept of various IOT Protocols
CO6: Select sensors and actuators for industrial applications

Course Contents

Unit I	**IoT**	**(2 Hours)**

Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications

Unit II	**IoT Physical Devices and Endpoints**:	**(2 Hours)**

Basic building blocks of and IoT device, Exemplary device: NodeMCU, Aurduino, and Other IoT Devices.

Unit III	**Sensors**	**(2 Hours)**

Roles of Sensors & Actuators, Types of sensors, Active and passive, analog and digital, Contact and no-contact, Absolute and relative		
Unit IV	**Working of Sensors**	**(3 Hours)**
Position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor, camera. Development boards		
Unit V	**IoT Protocols**	**(2 Hours)**
MQTT, CoAP, XMPP and AMQT, IoT communication models, IoT Communication technologies: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, LiFi, Wi-Fi, Interfacing of wifi, RFID, Zigbee,NFC with development board		
Unit VI	**Applications of IOT**	**(3 Hours)**
Smart Home: Characteristics of Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges. Smart Agricultural: characteristics and applications -Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor- based field and resource mapping, Remote equipment monitoring)		

Learning Resources

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515 2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012. ISBN : 9781439892992
2. Raj Kamal, Internet of Things: Architecture and Design Principle” , ISBN-13: 978- 93-5260- 522-4, McGraw Hill Education (India) 2017

Reference Books:

1. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning.
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally HakimaChouchi, “The Internet of Things Connecting Objects to the Web”, ISBN 078 - 1- 84821-140-7, Wiley Publications Asoke K Talukder and Roopa R Yavagal, “Mobile Computing,” Tata McGraw Hill, 2010.

MOOC / NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://nptel.ac.in/courses/106105166

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester II

Course Type: MMC	**Lab Course Title**: IOT Basics and Applications	
Course Code: 230GETM16_02	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 2 **Experiential Learning (EL):**	**Practical (PR):** 50 marks **Oral (OR):** 50 marks

Prerequisite Courses, if any: -

List of Laboratory Experiments	
Group A	
1.	Controlling GPIO pins in NodeMCU.
2.	LED blinking using Node MCU(Digital Write)
3.	Controlling LED using push button with NodeMCU (Digital Read)
4.	Temperature measurement using thermistor and NodeMCU Communication between Two NodeMCU using
5.	Smart lighting system using LDR and NodeMCU Study of smart material actuators.
Group B	
6.	Motion Detection using PIR Sensor and NodeMCU
7.	Gas detection using MQ135 and NodeMCU Experimental characterization of any one sensor.
8.	Servo motor (SG-90) control using NodeMCU Experimental characterization of DC motor
9.	Harmful gas monitoring using NodeMCU and ThingSpeak
Group C	
10.	Designing Weather station by HTTP GET REQUEST-RESPONSE using NodeMCU
11.	Design based experiment aiming selection of sensors for industrial application.

JSPM University Pune

Faculty of Science and Technology

School of Civil and Environmental Sciences

NEP aligned Syllabus

for

M. Tech (Structural Engineering)

(Effective from AY: 2025-26)

JSPM University Pune

	FACULTY OF SCIENCE & TECHNOLOGY	W. E. F	2025-2026
	SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES	RELEASE DATE	01/07/2025
SECOND YEAR MASTER OF TECHNOLOGY (STRUCTURAL ENGINEERING)		REVISION NO.	0.0 (NEP)

COURSE STRUCTURE (NEP 2020 Aligned)

SEMESTER III (LEVEL 7)

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 marks)	CONTINUOUS INSEMESTER EVALUATION (50marks)	END SEMESTER EXAMINATION (50 marks)	CONTINUOUS INSEMESTER EVALUATION (50marks)	END SEMESTER EXAMINATION (50 marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PEC	-	Program Elective-I / MOOCs	3	-	-	-	30	30	40	100	-	-	-	-	100	3
PEC	-	Program Elective-II / MOOCs	3	-	-	-	30	30	40	100	-	-	-	-	100	3
IOC	-	Interdisciplinary Open Course -I	2	-	-	-	30	30	40	100	-	-	-	-	100	2
IOC	-	Interdisciplinary Open Course -II	2	-	-	-	30	30	40	100	-	-	-	-	100	2
VEC	230USYB01_03	Behavioral Science and Ethics	2	-	-	-	30	30	40	50	-	-	-	-	50	2
SLC	240GSEM03_03	Seminar	-	-	-	8	-	-	-	-	-	-	50	50	50	2
PROJ	240GSEM01_03	Field Project	-	-	4	8	-	-	-	-	50	50	50	50	100	4
TOTAL			12	0	8	8									**600**	**18**
MLC#	-	Audit Course - I	1	-	-	-	-	-	-	50	-	-	-	-	50	1

L-Lecture T-Tutorial P-Practical Session (Laboratory) EL-Experiential Learning

Sem.	Interdisciplinary Open Course (IOC)		
	Specialization	**(IOC – I)**	**(IOC – II)**
III	**Course Code**	250GCSM03_03	230GCSM33_03
	Course Name	Fundamentals of Artificial Intelligence and Machine Learning	Introduction to Python Programming
III	**Course Code**	230VMSM11_03	230VBCB04_03
	Course Name	Fundamentals of Financial Management	Basics of Accounting

Sem.	Programme Elective Course (PEC)				
	Specialization	**Structural Engineering**			
III (PEC – I)	**Course Code**	230GSEM08_03	230GSEM09_03	230GSEM10_03	230GSEM30_03
	Course Name	Theory of Plates and Shells	Theory of Elasticity and Plasticity	Advanced Design of Steel Structures	Seismology
III (PEC – II)	**Course Code**	230GSEM11_03	230GSEM12_03	230GSEM13_03	230GSEM31_31
	Course Name	Structural Health Monitoring and Retrofitting	Soil Structure Interaction	Stability Analysis of Slopes, Dams and Embankments	Geotechnical Earthquake Engineering
IV (PEC – III)	**Course Code**	230GSEM14_04	230GSEM15_04	230GSEM16_04	230GSEM32_04
	Course Name	Micro-Structure and Innovations in Structural Concrete	Advanced Concrete Technology and Applications	Prefabricated Structures	Design of Masonry Structures
IV (PEC – IV)	**Course Code**	230GSEM17_04	230GSEM18_04	230GSEM21_04	230GSEM33_04
	Course Name	Design of Substructure	Design of Tall Buildings	Design of Steel Concrete Composite Structures	Performance Based Seismic Design

Sem	Mandatory Learning Course (MLC#) - Audit Course	
III (Audit Course- I)	**Course Code**	230GSEM29_03
	Course Name	Structural Audit
IV (Audit Course- II)	**Course Code**	230UPOB02_04
	Course Name	Introduction to Indian Constitution

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - I	**Course Title:** Theory of Plates and Shells	
Course Code: 230GSEM08_03	**Teaching Scheme:** 3Hrs./Week	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

1. Engineering Mechanics
2. Analysis of Structures

Course Objectives:

1. To develop a fundamental understanding of the behavior of thin plates and shell structures under various loading.
2. To impart knowledge of mathematical modeling and analytical techniques for solving bending, problems in plates and shells.
3. To enable students to analyze and design practical engineering structures involving plates and shells.

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

CO1: Derive the expressions of the curvature and displacement relationships of plates subjected to bending moments, twisting moments and shear force.
CO2: Analyze the simply supported plates and solve them by using Navier's and Levy's Methods.
CO3: Analyze plates subjected to plain forces.
CO4: Derive displacement relations for shells.
CO5: Analyze the thin shell structures using membrane theory.
CO6: Design the cylinder shell and review the IS codal provisions of it.

Course Contents

Unit I	**Basic curvature and displacement relationships.**	**(7 Hours)**
Expressions for bending, moment, twisting moments, shear forces		
Unit II	**Plate equation**	**(8 Hours)**
Edge conditions. Solution of simply supported plates by Navier's and Levy's methods. Introduction to anisotropic plates.		
Unit III	**Plate subjected to in plane forces**	**(7 Hours)**
Buckling of plates. Numerical analysis of plates. Design of plates		
Unit IV	**Shell structure**	**(8 Hours)**
Classification, Differential geometry, Curvature, Strain, Displacement relations		

Unit V	Membrane theory of thin shells	(7 Hours)
Membrane Theory, design of cylindrical shells of double curvature (synclastic and anticlastic), Shells of revolution, North light shell.		

Unit VI	Design of shell	(8 Hours)
Design of shell and review of IS code provisions, Introduction to bending theories: Application to cylindrical shells and design.		

Learning Resources

Text Books:

1. Theory of Plates and Shells: Timoshenko and Krieger, McGraw Hill
2. Theory and Analysis of Plates: Classic and Numerical Methods, Rudolph Szilard, Prentice Hall Inc. New Jersey

Reference Books:

1. Design and Construction of Concrete Shell Roofs : G.S. Ramaswamy, CBS Publisher & Distributors (2005)

MOOC / NPTEL Courses:

1. NPTEL Course “Plates and Shells”, Prof. Sudip Talukdar, IIT Guwahati
   https://archive.nptel.ac.in/courses/105/103/105103209/:

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - I	**Course Title:** Theory of Elasticity and Plasticity	
Course Code: 230GSEM09_03	**Teaching Scheme:** 3 Hrs./Week	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

Course Objectives:

1. To develop an in-depth understanding of three-dimensional stress and strain analysis.
2. To equip students with the ability to analyze two-dimensional problems in Cartesian and polar coordinates.
3. To introduce fundamental concepts of plasticity
4. To enable students to apply complex variable methods and energy principles in solving elasticity problems, including torsion and bending in non-standard geometries.

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

CO1: Understand and explain the fundamental concepts of elasticity and plasticity.
CO2: Analyze plane elasticity problems in Cartesian coordinates.
CO3: Analyze plane elasticity problems in Polar coordinates.
CO4: Interpret plastic stress-strain relations and examine the yield criteria.
CO5: Evaluate plastic deformation using theoretical models such as St. Venant's and Reuss's theories.
CO6: Analyze steady state problems in plane strain.

Course Contents

Unit I	**Introduction to Theory of Elasticity & Plasticity**	**(7 Hours)**
Plane strain and Plane stress of theory of elasticity, Methods of analysis		
Unit II	**2-D elasticity problems in Rectangular Coordinates**	**(8 Hours)**
2-Dimensional problems in Cartesian coordinates, Bending of beams		
Unit III	**2-D elasticity problems in Polar Coordinates**	**(7 Hours)**
General Equation, Pure bending, Torsion in Circular rods		
Unit IV	**3-D elasticity Problems**	**(8 Hours)**
Principal stresses, Stress invariants, Homogeneous deformation, strain at a point		
Unit V	**Plasticity – Theoretical Models and Deformation**	**(7 Hours)**

Constitutive relations, Problems contained plastic deformation, True stress-strain curve, strain rate effects, idealization, Yield criteria.		
Unit VI	**Steady state problems in plane strain**	**(8 Hours)**
Plastic stress-strain relations, Symmetrical extrusion, Unsymmetrical extrusion, Plasticity Problems		

Learning Resources

Text Books:

1. Richard. G. Budynas, "Advanced Strength and Applied Stress Analysis" Mc Graw-Hill, New Delhi, Second Edition, 2011
2. Chakrabarty JN, "Theory of Plasticity", Tata McGraw Hill Book Co., New Delhi, Third Edition, 2006

Reference Books:

1. Mendelson. A., "Plasticity - Theory and Applications", Krieger Pub Co., Florida, U.S.A, Second edition,1983.
2. Chwo. P. C. and Pagano. N. J. "Elasticity Tensor, Dyadic and Engineering Applications", D. Van Nastrand and Co., Inco. 1990
3. Wang CK, "Applied Elasticity", Mc Graw Hill, New Delhi, 1990

MOOC / NPTEL Courses:

1. NPTEL Course “Theory of Elasticity”, Prof. Biswadip Banerjee, IIT Kharagpur
   https://archive.nptel.ac.in/courses/105/105/105105177/

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - I	**Course Title:** Advanced Design of Steel Structures (ADSS)	
Course Code: 230GSEM10_03	**Teaching Scheme:** 3Hrs./Week	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

Course Objectives:

1. To know the different types of steel sections and relevant IS codes
2. To understand the concept of design of flexural members
3. To understand the design of compression members
4. To understand the design tension members
5. To understand the design procedure of Plate girder
6. To understand the design procedure of Gantry Girder

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

CO1: Know the different types of steel sections and relevant IS codes
CO2: Understand the concept of design of flexural members
CO3: Understand the design compression members
CO4: Understand the design tension members
CO5: Understand the design procedure of Plate girder
CO6: Understand the design procedure of Gantry Girder

Course Contents

Unit I	**Introduction**	**(7 Hours)**
Properties of steel: mechanical properties, hysteresis energy, Hot-Rolled Sections: plastic, compact, semi-compact and slender sections, slenderness ratio, and residual stress. The Basis of Structural Design, Concept of Limit State Design, Loading and Load Combinations		
Unit II	**Design of beams**	**(8 Hours)**
Beams: Allowable stresses, design requirements as per IS Code-Design of simple and compound beams- check for deflection, shear, buckling, check for bearing, laterally Supported and unsupported beams		
Unit III	**Design of Compression members**	**(7 Hours)**
Compression members: effective length of columns. Slenderness ratio –Permissible stresses. Design of compression members, struts etc. Design of Columns, Built up compression members – Design of lacings and battens		
Unit IV	**Design of Tension members**	**(8 Hours)**
Tension Members and compression members: General Design of members subjected to direct tension. Roof Trusses: Different types of trusses – Design loads – Load combinations as per IS Code		

recommendations, Design of purlins		
Unit V	**Design of Plate Girder**	**(7 Hours)**
Design of Plate Girder: Design consideration – IS Code recommendations Design of plate girder-Welded – Curtailment of flange plates, stiffeners – splicing and connections.		
Unit VI	**Design of Gantry Girder**	**(8 Hours)**
Design of Gantry Girder: impact factors - longitudinal forces, Design of Gantry girders		

Learning Resources

Text Books:

1. N. Subramanian, Design of Steel structures, Oxford University Press
2. IS 800 (2007), Indian Standard General Construction in Steel - Code of Practice, Bureau of Indian Standards

Reference Books:

1. P. Dayaratnam, Design of Steel Structures, S. Chand Group
2. B. Bresler, T. Y. Lin and J. B. Scalzi, Design of Steel structures, John Wiley & Sons

MOOC / NPTEL Courses:

1. NPTEL Course “Advanced design of steel structures”, Prof. Srinivasan Chandrasekaran, IIT Madras
   https://onlinecourses.nptel.ac.in/noc22_oe02/preview

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - I	**Course Title:** Seismology	
Course Code: 230GSEM30_03	**Teaching Scheme:** 3Hrs./Week	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

Course Objectives:

1. To develop a fundamental understanding of the generation and propagation of earthquake waves.
2. To impart knowledge about the seismicity of the Earth.
3. To familiarize students with key earthquake parameters.
4. To train students in the processing, analysis, and interpretation of earthquake data.
5. To provide an understanding of seismic hazard zoning, design earthquake parameters

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

CO1: Explain the physical principles governing the propagation of seismic waves and interpret travel-time curves with respect to Earth's internal structure.
CO2: Gain a thorough, and critical understanding of advanced seismology and causes of earthquakes.
CO3: Differentiate between various earthquake parameters such as magnitude, intensity, and ground acceleration, and assess their relevance in seismic hazard estimation.
CO4: Demonstrate proficiency in the operation and interpretation of data from different types of seismographs and earthquake recording systems.
CO5: Process raw seismic data to extract critical parameters like epicentral distance, focal depth, and magnitude, and evaluate seismic source characteristics.
CO6: Apply seismic zoning information and ground motion characteristics to determine design-level earthquake parameters for engineering applications.

Course Contents

Unit I	**Introduction**	**(7 Hours)**
Propagation of earthquake Waves, Body & surface waves, laws of reflection, refraction and attenuation, travel times curves, internal structure of earth		
Unit II	**Seismicity of Earth**	**(8 Hours)**
Seismicity of earth, major earthquakes in the world, important Indian Earthquakes, earthquake catalogs, plate tectonics, causes of earthquakes		
Unit III	**Earthquake Parameters**	**(7 Hours)**
Magnitude, energy, intensity, acceleration, return period, frequency, Ground motion characteristics		
Unit IV	**Earthquake Recording**	**(7 Hours)**
Earthquake recording instruments, seismographs, different modes of recording analogue, digital, microearthquake, teleseismic, local, strong motion, band width and their engineering implications		

Unit V	Processing of Earthquake Data	(8 Hours)
Processing, analysis and interpretation of earthquake data, determination of magnitude, epicentral distance, focal depth, focal mechanism, seismic hazard and risk, seismic zoning.		
Unit VI	**Earthquake Prediction**	**(8 Hours)**
Earthquake precursors: Geophysical, Seismological and Geochemical precursors before a large earthquake, and earthquake and tsunami early warning system.		

Learning Resources

Text Books:

1. Agrawal, P.N., Engineering Seismology, Oxford& IBH Publishing Co. Pvt. Ltd, New Delhi.
2. Richter, C.F. Elementary Seismology, Eurasia Publishing House (Pvt) LTD, New Delhi.
3. Aki,K and Richard, P.G. Quantitative seismology, Theory and Methods, Vol. I and II, W. H. Freeman & Co.

Reference Books:

1. Stein, S. and Wyssession, M., "An Introduction to Seismology, Earthquakes and Structure", Blackwell Publishing 2003
2. Lay, T. and Wallace, T.C., "Modern Global Seismology", Academic Press 1995

MOOC / NPTEL Courses:

1. NPTEL Course "Introduction to Engineering Seismology", Prof. P. Anbazhagan, IISC Banglore. https://nptel.ac.in/courses/105108204

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - II	**Course Title:** Structural Health Monitoring and Retrofitting	
Course Code: 230GSEM11_03	**Teaching Scheme:** Hrs./Week	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory: 100 marks**

Prerequisite Courses, if any:

1.Fundamentals of Civil Engineering Materials
2. Structural Mechanics

Course Objectives:

- To provide students with a comprehensive understanding of Structural Health Monitoring (SHM) principles.
- To make the students proficient in conducting structural audits and utilizing both static and dynamic methods for assessing the integrity of structures.
- To equip students with the skills to select appropriate materials, sensors, and repair techniques for the maintenance and retrofitting of structures.

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

CO1 Understand the fundamentals of Structural Health Monitoring (SHM).
CO2 Apply appropriate Non-Destructive Testing (NDT) methods during a structural audit to assess the condition of a structure.
CO3 Understand the principles behind static and dynamic testing methods used in SHM.
CO4 Apply the knowledge of smart materials in designing effective SHM systems.
CO5 Comprehend the functioning of various sensors and transducers used in SHM.
CO6 Apply suitable repair techniques and materials to strengthen damaged structures.

Course Contents

Unit I	Introduction to Structural Health Monitoring	(7 Hours)

Factors affecting the health of structures, Need and Objective of SHM, Types of Maintenance, Various steps in SHM, SHM system components, damage diagnostic steps, challenges in aging infrastructure, case studies.

Unit II	Structural Audit	(8 Hours)

Need and its importance of Structural audit, Study of structural and architectural drawings, Nature of distress, Tools for investigation – visual inspection, Non-Destructive Testing (NDT) methods – Rebound Hammer Test, Ultrasonic Pulse Velocity Test (UPV), Concrete Endoscopy, Penetration Resistance Test, Pullout Test, Core Sampling and Testing, Chemical Tests – Carbonation Test, Chloride Content Test, Corrosion Assessment, Presentation of the audit report.

Unit III	Static Methods and Dynamic Methods	(8 Hours)

Introduction to static and dynamic field testing, Static testing techniques – Behavior Tests, Diagnostic Tests, Proof Load Tests, Dynamic testing techniques – Stress History Tests, Dynamic Load Allowance (DLA) Test, Ambient Vibration Test, Pullback Test.		
	Smart Materials for SHM	**(8 Hours)**
Introduction and necessity of smart materials, Classification of smart materials, Mechanisms and behavior of smart materials, Applications of Smart Materials in SHM systems, Types of smart materials – Piezoelectric Materials, Magnetostrictive Materials, Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Alloys, Role of smart engineering materials in health monitoring.		
Unit V	**Instrumentation and Sensors for SHM**	**(7 Hours)**
Importance of sensors and instrumentation in SHM, Types of sensors and transducers technologies used, Data acquisition systems and techniques – Data Processing – Diagnostic techniques – Measurement of Parameters, Instrumentation and Sensor-Based Monitoring Procedure in SHM.		
Unit VI	**Repair and Retrofitting of Structures**	**(7 Hours)**
Introduction to retrofitting and its importance, Need for repair and maintenance, Types of distress and causes of structural damage, Criteria for selection of retrofitting techniques, Techniques for retrofitting and strengthening, Materials used in repair.		

Learning Resources

Textbooks:

1. Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes "*Structural Health Monitoring*", John Wiley and Sons, 2006.
2. Douglas E Adams, "*Health Monitoring of Structural Materials and Components Methods with Applications*", John Wiley and Sons, 2007.

Reference Books:

1. Wu, Z.S. (Editor), Structural health monitoring and intelligent infrastructure, Volumes 1 and 2, Balkema.
2. Fu Ko Chang, Structural Health Monitoring: Current Status and Perspectives,
3. B. Culshaw, Smart Structures & Materials, Artech House, Boston.
4. Modi, Poonam I. Patel, Chirag N., "*Repair and Rehabilitation of concrete Structures*" PHI Publication, First Edition 2016.
5. J. Bhattacharjee, "*Concrete Structures Repair, Rehabilitation and Retrofitting*", CBS Publication, First Edition 2019.
6. Charles R Farrar, and Keith Worden, "*Structural Health Monitoring: A Machine Learning Perspective*", John Wiley & Sons, First edition.
7. Nagayama, T. and Spencer Jr, B.F., *Structural health monitoring using smart sensors*, NSEL Report Series, 2007.
8. J.P. Ou, H. Liand Z.D. Duan, "*Structural Health Monitoring and Intelligent Infrastructure*", Taylor and Francis Group, London, UK, 2006.
9. Victor Giurglutiu, "*Structural Health Monitoring with Wafer Active Sensors*", Academic Press Inc, 2007.

MOOC / NPTEL Courses:

1. NPTEL Course "*Structural health monitoring*" S. Chandrasekaran, IIT Madras. Link of the Course: https://archive.nptel.ac.in/courses/114/106/114106046/

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - II	**Course Title:** Soil Structure Interaction	
Course Code: 230GSEM12_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

1. Geotechnical Engineering/Soil Mechanics
2. Structural Analysis

Course Objectives:

- To equip learners with the skills to design shallow foundations effectively.
- To provide a comprehensive understanding of the key concepts and principal components of Soil-Structure Interaction (SSI).
- To develop the ability to address foundation problems associated with infinite beam conditions, including applications like railroad tracks and long strip footings.
- To address the foundation problems related to semi-infinite beam.
- To enhance the skills to address foundation problems related to finite beam conditions, such as continuous strip footings and combined foundations.
- To enhance understanding and problem-solving skills for foundation issues related to plate conditions, specifically raft foundations.

Course Outcomes: Students completing the course will be able to:

CO1: Design the shallow foundation effectively.

CO2: Understand various concepts applicable to Soil-Structure-Interaction and the principal components of Soil-Structure-Interaction

CO3: Address foundation problems related to infinite beam conditions, such as railroad tracks and long strip footings.

CO4: Address foundation problems related to semi-infinite beam conditions.

CO5: Address foundation problems related to finite beam conditions, including continuous strip footings and combined foundations.

CO6: Address foundation problems related to plate conditions, such as raft foundations.

Course Contents

Unit I	Conventional methods of shallow foundation	(9 Hours)

Introduction, critical study of conventional methods of shallow foundation design: bearing capacity and settlement calculation. Terzaghi's bearing capacity theory, Meyorhof's analysis, IS code method.

Unit II	Fundamentals of Soil-Structure Interaction	(8 Hours)

Contact pressure and Soil-Structure Interaction (SSI) for shallow foundation, concept of subgrade modulus, determination of subgrade modulus, parameters influencing subgrade modulus. Different foundation models (such as one-parameter, two-parameter models etc.) with linear and nonlinear stress-strain characteristics, Time-dependent response.

Unit III	Beam on elastic foundation-Infinite Beam	(8 Hours)
Beams on Elastic Foundation, infinite beam, infinite beam subjected to various loading conditions including point load, uniformly distributed load, triangular load, concentrated moment and combinations of load. Multiple loading condition on infinite beam. Beam with support reaction and determination of support reaction.		
Unit IV	**Beam on elastic foundation-Semi-infinite Beam**	**(6 Hours)**
Semi-infinite beam, Beam with semi-infinite length and various end conditions i.e., beam with free end, beam with hinged end, beam with fixed end. Semi-infinite beam with different loading conditions i.e., point load, and uniformly distributed load (UDL).		
Unit V	**Beam on elastic foundation-Finite Beam**	**(7 Hours)**
Beams with finite length, Beams with finite length and various end conditions, continuity among the foundation soil layers, beams on two-parameter soil medium (infinite and finite beam).		
Unit VI	**Plates on Elastic Foundation**	**(7 Hours)**
Plates on Elastic Foundation (rectangular and circular), plates on two-parameter soil medium**.**		

Learning Resources

Text Books:

1. Bull J. W., Soil-Structure Interaction: Numerical Analysis and Modelling, CRC Press, 1st edition, 1994..
2. Hetenyi, Beams on Elastic Foundation, The University of Michigan Press, 1st edition, 1979.

Reference Books:

1. Bowels, J.E., Analytical and Computer Methods in Foundation, McGraw Hill Book Co., New York, 1st edition, 1974.
2. Desai C. S. and Christian J.T., Numerical Methods in Geotechnical Engineering, McGraw Hill Book Co., New York, 1st edition, 1977.
3. Selvadurai A. P. S., Elastic Analysis of Soil-Foundation Interaction, Elsevier Scientific, Amsterdam, 1st edition, 1979.
4. Woodward J. and Tomlinson M., Pile Design and Construction Practice, Chapman & Hall, 4th edition, 1994.
5. Davis H. G. and Poulos E. H., Pile Foundation Analysis and Design, Rainbow-Bridge Book Co., 1st edition, 1980.

MOOC / NPTEL Courses:

1. NPTEL Course "*Soil Structure Interaction*", Prof. Kousik Deb, IIT Kharagpur
Link of the Course:
https://archive.nptel.ac.in/courses/105/105/105105200/

Additional Web Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ce03/preview#

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S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - II	**Course Title:** Stability Analysis of Slopes, Dams and Embankments	
Course Code: 230GSEM13_03	**Teaching Scheme:** 3Hrs./Week	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

1. Soil Mechanics
2. Foundation Engineering

Course Objectives:

1. To provide a fundamental understanding of slope failure mechanisms.
2. To introduce classical and advanced analytical methods for evaluating slope stability under static and seismic conditions.
3. To develop an understanding of reinforced slopes, dams and embankments.
4. To impart knowledge about earth and rockfill dams, including design principles, materials, site selection, causes of failure, and instrumentation for monitoring.

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

CO1: Identify different types of slope failures and analyze slope stability using planar, circular, and non-circular failure surfaces under various stress conditions.
CO2: Determine factor of safety in slope stability problems, including tension cracks and vertical cuts.
CO3: Analyze slopes with non-circular failure surfaces using advanced methods.
CO4: Evaluate different slope stabilization methods including drainage, soil reinforcement, soil treatment (lime/cement), and surface protection techniques.
CO5: Design and analyze reinforced slopes and embankments considering reinforcement types, allowable forces, and foundation conditions.
CO6: Explain the design principles of earth and rockfill dams, assess causes of failure, and describe various instrumentation techniques for monitoring dam safety.

Course Contents

Unit I	**Introduction to Slope Stability and Types of Failures**	**(7 Hours)**
Types of slope failures, Failure surfaces: Planar, Circular, and Non-circular, Limit equilibrium methods, Total stress vs. Effective stress analysis, Bishop's pore pressure parameters, Short-term and long-term slope stability		
Unit II	**Classical Methods for Slope Stability Analysis**	**(8 Hours)**
Taylor's Stability Charts, Effect of tension cracks, Stability of vertical cuts, Bishop's method of analysis, Bishop and Morgenstern analysis		
Unit III	**Advanced Slope Stability Analysis**	**(7 Hours)**

Non-circular failure surface analysis: Morgenstern and Price Method, Janbu Method, Sliding Block Analysis; Seismic stability of slopes		
Unit IV	**Slope Stabilization Techniques**	**(8 Hours)**
Drainage measures for slope stability; Soil reinforcement methods: Geosynthetics, Soil nailing, Micropiles; Soil treatment techniques: Cement/lime stabilization, Thermal treatment; Surface protection techniques: Vegetation, Erosion control mats, Shotcrete		
Unit V	**Reinforced Slopes and Embankments**	**(7 Hours)**
Types of reinforcement, Reinforcement forces and allowable forces, Factors of safety in reinforced slopes, Reinforced slopes on firm foundations, Embankments on weak foundations		
Unit VI	**Earth and Rockfill Dams**	**(8 Hours)**
General features and site selection, Merits and demerits of earth and rockfill dams, Classification of earth dams, Materials and their requirements, Causes of failure and safe design criteria, Instrumentation in earth dams: Pore pressure measurement, Settlement gauges, Inclinometers, Stress and seismic measurements		

Learning Resources

Text Books:

1. Christian Kutzner, “Earth & Rock fill dams – Principles of design and construction”, Published Oxford and IBH
2. Bharat Singh, “Earth and Rock fill dams”

Reference Books:

1. USIBR, “Design of small dams” Oxford and IBH Publishing Company

MOOC / NPTEL Courses:

1. NPTEL Course “Advanced Geotechnical Engineering”, Dr. B.V.S. Viswanadham, IIT Bombay
   https://nptel.ac.in/courses/105101001

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S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: PEC - II	**Course Title:** Geotechnical Earthquake Engineering	
Course Code: 230GSEM31_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

1. Geotechnical Engineering/Soil Mechanics

Course Objectives:

- To understand the requirement of geotechnical earthquake engineering.
- To provide a comprehensive understanding of strong ground motion parameters.
- To equip students with the concepts and methodologies of seismic hazard analysis.
- To develop an understanding of wave propagation through various soil media.
- To impart knowledge of dynamic soil properties.
- To understand the concept of liquefaction related phenomena.

Course Outcomes: Students completing the course will be able to:

CO1: Solve problems relating to origin of earthquakes and response of structures to earthquake vibrations.
CO2: Evaluate ground motion characteristics using various magnitude and intensity scales, and interpret spectral parameters for engineering applications.
CO3: Solve problems relating to hazard analysis.
CO4: Assess properties of soil affected by seismic wave propagation.
CO5: Determine dynamic soil properties.
CO6: Assess the potential for soil liquefaction at a site.

Course Contents

Unit I	**Introduction**	**(5 Hours)**

Scope and objective, Nature and types of earthquake loading, Importance of Geotechnical Earthquake Engineering. Basics of Engineering Seismology

Unit II	**Strong Ground Motion**	**(8 Hours)**

Size of Earthquake: Magnitude and Intensity of Earthquake, Modified Mercalli Intensity Scale, Measuring of Earthquake, Earthquake Magnitude- Local (Richter) magnitude, surface wave magnitude, Moment magnitude, Seismic energy, Correlations. Spectral Parameters: Peak Acceleration, Peak Velocity, Peak Displacement, Frequency, Content and duration, Spatial Variability of Ground Motion, Attenuation Relationships.

Unit III	**Seismic Hazard Analysis**	**(10 Hours)**

Magnitude Indicators, Segmentation, Deterministic Seismic Hazard Analysis (DSHA), Probabilistic Seismic Hazard Analysis (PSHA), Earthquake Source Characterization, Gutenberg-Richter recurrence law, Predictive relationships, temporal uncertainty, Probability computations, Seismic Hazard Curve

Unit IV	Wave propagation	(7 Hours)
Waves in unbound media; Waves in semi-infinite media; Waves in layered media, Seismic Travel Time Curve, Three Circle Method for locating an Earthquake's Epicentre.		
Unit V	**Dynamic soil properties**	**(8 Hours)**
Stiffness, damping and plasticity parameters of soil and their determination (laboratory testing, intrusive and non-intrusive in-situ testing), Correlations of different soil parameters.		
Unit VI	**Liquefaction**	**(7 Hours)**
Basic concept, flow liquefaction, cyclic mobility, liquefaction susceptibility, effects.		

Learning Resources

Text Books:

1. Kramer S. L, "Geotechnical Earthquake Engineering", Prentice Hall
2. Day, R. W, "Geotechnical Earthquake Engineering Handbook", McGraw Hill

Reference Books:

1. Ishihara Kenji, "Soil Behaviour in Earthquake Geotechnics" Oxford University Press, USA

MOOC / NPTEL Courses:

1. NPTEL Course "Geotechnical Earthquake Engineering", Prof. Deepankar Choudhury, IIT Bombay
   https://archive.nptel.ac.in/courses/105/101/105101134/#

JSPM University Pune

S.Y. M. Tech. "Civil Engineering (AIML)"

Semester- III

Course Type: IOC -I	**Course Title:** Fundamentals of Artificial Intelligence and Machine Learning	
Course Code: 250GCSM03_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

- Algorithms.
- Probability Theory
- Statistics
- Computer Science.

Course Objectives:

- To learn basics of Artificial Intelligence including core features.
- To study different types of AIML and its Application.
- To understand the importance of AI for Industries.
- To use AI and ML various domains of Civil Engineering.

Course Outcomes: On completion of the course, the learner will be able to:
CO1: Understand the basics of AI and ML application for Industries.
CO2: Apply various Tools & Technology for AIML.
CO3: Implement the AIML for real-world problems.
CO4: Analysis the functionality of AIML.
CO5: Evaluate the performance of Tools & Technology applied in Industries.
CO6: Understand and solve various civil engineering problems using AI and ML

Course Contents

Unit I	Introduction to AIML	(5 Hours)

Scope of the Course, Introduction to AI and ML, Brief review of History of AI and ML, Related fields. Concept of AI, Types of AI, Characteristics of AI, Key aspects of AI, Important of AIML, Application of AI.

Unit II	Regression Analysis	(5 Hours)

Overview of Machine Learning, Linear regression, Types of linear regression, Application of linear regression, Real-world use cases of linear regression, Logistics Regression, Models with multiple features, Correlation and Classification.

Unit III	**Application of ML**	**(5 Hours)**
Introduction to Clustering, Types of Clustering, Segmentation, Anomaly detection, and pattern recognition. Clustering Algorithms in Machine Learning: K-Mean, Applications of Clustering, Advantages Clustering.		
Unit IV	**Bayesian Application**	**(5 Hours)**
An overview of Bayesian Networks in AI, Application of Bayesian networks in AI, Bayesian Network Model, Probabilistic Graphical Model. Decision Graph, Risk Model with Bayesian Network, Dynamic Bayesian Model.		
Unit V	**Infrastructure Monitoring and Management**	**(5 Hours)**
Introduction to infrastructure monitoring, Data integration with AIML, Ethical considerations in AI and ML Applications, Regulatory challenges and standards in civil engineering,		
Unit VI	**Case Study/Project**	**(5 Hours)**
Structural Analysis and Design, Construction Management, Geotechnical Engineering, Transportation Engineering, Environmental Engineering, Smart Cities and Sustainable Development, Building Information Modeling, Responsible AI development and deployment.		

Learning Resources

Text Books:

1. AI and Machine Learning with Python for Everyone, Mark Fenner, Pearson
2. Machine Learning, Anuradha Srinivasaraghavan, Vincy Joseph, Wiley
3. Machine Learning with Python, U Dinesh Kumar Manaranjan Pradhan, Wiley

Reference Books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithms : Synthesis and Applications By S. Rajshekharan, G. A. Vijayalakshmi Pai, PHI
2. KishanMehrotra, Chilukuri Mohan and Sanjay Ranka, Elements of Artificial Neural Networks, Penram International
3. Tom Mitchell, Machine Learning, TMH
4. AthemEalpaydin, Introduction to Machine Learning, PHI 8. Andries P. Engelbrecht, Computational Intelligence - An Introduction, Wiley Publication

MOOC / NPTEL Course:

1. NPTEL Course titled “AIML Applications” IIT Madars, by Prof. C.A. Murthy and Prof. Sukhendu Das.

Link:1. https://www.geeksforgeeks.org/machine-learning/
2. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: IOC - I	**Course Title:** Fundamentals of Financial Management	
Course Code: 230VMSM11_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

- Basics of Accounting
- Principles of Economics, Business Mathematics

Course Objectives:

- To provide an understanding of the core concepts of financial management and its importance in business decisions.
- To equip students with the skills to analyze financial statements and understand the financial health of a business.
- To develop the ability to make informed financial decisions and manage financial risks.
- To introduce recent trends and industry practices in financial management.

Course Outcomes:

CO1: Explain the fundamental concepts of financial management
CO2: Analyze financial statements to assess the financial performance of an organization
CO3: Apply financial management techniques to make investment and financing decisions
CO4: Evaluate financial risks and devise strategies to mitigate them
CO5: Integrate knowledge of recent trends and industry practices in financial decision-making
CO6: Demonstrate the ability to communicate financial information effectively

Course Contents

Unit I	Introduction to Financial Management	(5 Hours)
Definition, nature, and scope of financial management; Goals of financial management; Recent trends in financial management. Basic financial calculations (e.g., profit margin, return on investment)		

Unit II	Financial Analysis and Planning	(5 Hours)
Financial statement analysis; Ratio analysis; Cash flow and fund flow analysis. Calculation of financial ratios and interpretation (e.g., liquidity ratios, profitability ratios).		

Unit III	Time Value of Money	(5 Hours)
Concept of the time value of money; Present value and future value calculations; Applications in financial decision-making. Present value and future value problems, annuity calculations, discounting cash flows.		

Unit IV	Investment Decisions	(5 Hours)

Capital budgeting techniques; Risk analysis in capital budgeting; Recent trends in investment decisions.
Net present value (NPV), Profitability Index, IRR, payback period calculations.

Unit V	Financing Decisions	(5 Hours)

Cost of capital; Capital structure theories and planning; Sources of long-term finance.
Calculating the cost of equity, debt, and weighted average cost of capital (WACC).

Unit VI	Working Capital Management	(5 Hours)

Concepts and components of working capital; Management of cash, receivables, and inventory; Financing of working capital.
Working capital cycle, inventory turnover ratio, receivables turnover ratio.

Learning Resources

Text Books:

1. I.M. Pandey "*Financial Management*"
2. Richard A. Brealey, Stewart C. Myers, and Franklin Allen "*Principles of Corporate Finance*"

Reference Books:

1. Aswath Damodaran "*Corporate Finance*: *Theory and Practice*"
2. Eugene F. Brigham and Michael C. Ehrhardt "*Financial Management: Theory & Practice*"
3. David Hillier, Mark Grinblatt, and Sheridan Titman "*Financial Markets and Corporate Strategy*"
4. R. Charles Moyer, James R. McGuigan, and Ramesh P. Rao "*Contemporary Financial Management*"

MOOC / NPTEL Course:
Coursera Course on Financial Management

JSPM University Pune
S.Y. M.Tech. "Structural Engineering"
Semester- III

Course Type: IOC-II	**Course Title:** Basics of Accounting	
Course Code: 230VBCB04	**Teaching Scheme: (Hrs./ Week)**	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:
1.
2.

Course Objectives:
1. To foster a comprehensive understanding of the role and significance of monetary and financial transactions in business operations.
2. To develop an appropriate approach towards the classification of various transactions and their implications.
3. To develop proficiency in preparing basic financial statements, including Trading and Profit & Loss Accounts and Balance Sheets.
4. To understand the nature of the accounting relationship between customers and banks.

Course Outcomes: On completion of the course, the learner will be able to -
CO1: Remember fundamental accounting concepts and principles.
CO2: Understand the role and importance of monetary and financial transactions in business.
CO3: Apply appropriate classification to various financial transactions.
CO4: Analyze basic financial statements, including Trading and Profit & Loss Accounts and Balance Sheets.
CO5: Prepare basic financial statements from given financial data.
CO6: Rectifying errors in solved accounting problems with proper solutions if required.

Course Contents

Unit I	**Introduction to Basic Accounting & Bookkeeping**	**5 Hrs**
Basic Terminology in Accounting and Bookkeeping, Accounting Concepts, Accounting Conventions, GAAP, Types of Accounts and Rules, Types of Transactions		
Unit II	**Books of Accounting**	**5 Hrs**
Journal, Ledger, Subsidiary Books, Problems of Journal, Problems of Ledger, Problems of Trial Balance		
Unit III	**Cash Book and Subsidiary Books**	**5 Hrs**
Cash Book – Meaning and Definition, Cash Book – Need and Importance, Types of Cash Book, Subsidiary Book and its types		
Unit IV	**Preparation of Final Accounts**	**5 Hrs**
Types of Business, Need for Financial Statements, Formats of Financial Statements, Trading Account, Profit & Loss Account, Balance sheet, Problems of Final Accounts of Sole Trading Organizations		

Unit V	Depreciation & Provision for Bad and Doubtful Debts	5 Hrs
Meaning and Concept of Depreciation, Reasons for Depreciation, Methods of Depreciation		
Unit VI	**Bank Reconciliation Statement**	**5 Hrs**
Meaning of BRS, Need for BRS, Importance of BRS, Process of BRS, Formats of BRS, Preparation of BRS and Problems of BRS		

Learning Resources

Text Books:

1) P. Periasamy *'Financial, Cost, and Management Accounting'*, Himalaya Publishing Ltd.
2) Dr. Mahesh Abale and Dr. Shriprakash Soni, *'Managerial Accounting'*, Himalaya Publishing Ltd.

Reference Books:

1) Khan and Jain, *'Management Accounting'*, Tata McGraw Hill
2) Shankarnarayanan Ramanath, 'Financial Accounting for Management', CENGAGE Learning
3) S.N. Maheshwari & S.K. Maheshwari, 'Advance Accounting', Vikas Publication
4) M.C. Shukla, T.C. Grewal, S.C. Gupta, 'Advance Accounting', Sultan Chand and Sons
5) R.L. Gupta, M. Radhaswamy, 'Advance Accounting', Sultan Chand and Sons

MOOC / NPTEL Courses:

1) Swayam Course *"BCOC-131- Financial Accounting"*, Dr. N. Rajendra Prasad, Indira Gandhi National Open UniversityBCOC-131- Financial Accounting

Link of the Course:

1) https://onlinecourses.swayam2.ac.in/nou23_cm13/preview

Additional Web Resources:

1) https://icmai.in/
2) https://www.icai.org/
3) https://www.icsi.edu
4) https://www.cimaglobal.com/

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- III

Course Type: VEC	**Course Title:** Behavioral Science and Ethics	
Course Code: 230USYB01_03	**Teaching Scheme:**(Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L):** 2 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks

Prerequisite Courses, if any: -

Course Objectives:

- To prepare students for their future endeavors by imparting a sense of self, understanding their surroundings and their nation.
- The course also teaches strategies to lead healthy lifestyles with a positive attitude.
- It enables students to learn the process of problem solving and creative thinking.
- In the second part of the course, the students are being prepared for their professional development by inculcating leadership skills and ethical work values

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

CO1: Understanding sense of self, nation, and society they are living in
CO2: Applying strategies to manage stress and understanding stress and its consequences
CO3: Analyzing problem and Strategizing way to solve it
CO4: Evaluating group dynamics and leadership skills
CO5: Creating healthy and ethical workspace
CO6: Remembering values, morality, and ethics through thick and thin of life

Course Contents

Unit I	**Self**	**(5 Hours)**

I. What is Behavioural science and its significance
II. Self-awareness and its importance
III. Components of self and self-identity
IV. Self-concept
V. Self confidence
Self-image

Unit II	**Stress Management**	**(5 Hours)**

I. What is stress? and understanding reasons for stress.
II. What are possible consequences of the stress?
III. How to accept stress and share your emotions.
IV. What are strategies to manage stress?
V. Why seeking help is important when needed?.

Unit III	**Thinking, Perceiving and Problem Solving**	**(5 Hours)**

I. How to approach and analyze a problem?

II. How to think? III. How to strategize and plan actions? IV. How to implement plans of action? V. What is creative thinking and how to process it?		
Unit IV	**Indian Ethics**	**(5 Hours)**
I. Definition and characteristics of group II. What are external and internal conditions affecting group functioning? III. What are group conflict and group cohesiveness? IV. Meaning, nature and functions of leadership V. What are characteristics of a good leader?.		
Unit V	**Western Ethics**	**(5 Hours)**
I. Sources of Moral Ideals in India, Ethics: Its Meaning in Indian Tradition II. Ethics in Vedic Period, Ethics in Dharmasastras and Itihasas III. Way of Righteousness in the Gita, Ethical Concepts of Hindu Tradition IV. Ethics in Buddhism, Jaina Ethics		
Unit VI	**Growth, Scaling and Sustainable Business Practices**	**(6 Hours)**
I. Aristotle, Thomas Aquinas II. William of Ockham, Thomas Hobbes III. Jeremy Bentham, Immanuel Kant IV. John Stuart Mill **V.** Emile Durkheim		

Learning Resources

Text Books:

1. Bates,A.P and Jullian J " Sociology: Understanding social Behaviour", Houghton Mifflin, 1975.

Reference Books:

1. J William Pfeiffer (ed) Theories and Models in Applied Behavioural Science, Vol 2, Group (1996); Pfeiffer and company.
2. William Frankena K, Ethics, Prentice-Hall, Inc., 1973
3. https://dorshon.com/wp-content/uploads/2018/03/Ethics.pdf

MOOC / NPTEL Course:

1. NPTEL Course: "https://onlinecourses.nptel.ac.in/noc20_hs28/preview", Prof. Naveen Kashyap, IIT Guwahati

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester III

Course Type: SLC	**Lab Course Title:** Seminar	
Course Code: 240GSEM03_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 2	**Lecture (L): 0** **Tutorial (T): 0** **Practical (P):** 0 **Experiential Learning (EL): 8**	**Oral (OR):** 50 Marks

Prerequisite Courses, if any: -

Objectives:

- To develop skills in literature survey, technical writing, and oral presentation.
- To enhance communication, organization, and time management skills in a professional setting.
- To encourage critical thinking, knowledge synthesis, and presentation on contemporary issues in Construction Management.
- To build confidence in presenting technical concepts and real-life project experiences to a professional audience.
- To create an opportunity to analyze and reflect on field training or internship outcomes.

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

CO1: Conduct a structured literature survey on a relevant topic or project.
CO2: Identify, define, and frame a technical problem or theme for presentation.
CO3: Prepare a comprehensive seminar report following academic standards.
CO4: Deliver an effective oral presentation with confidence and clarity.
CO5: Demonstrate analytical thinking and communication skills.
CO6: Incorporate feedback from faculty and peers to improve their work.

Seminar Guidelines:

- Each student will select a topic related to their internship/field project, or a current trend/challenge/innovation in Construction Management.
- Topics must be approved by the Seminar Coordinator.
- Students are expected to consult journal papers, industry reports, codes, standards, and project documentation.
- A seminar report (hard and soft copy) must be submitted in the prescribed format.

Seminar Report Format (Recommended):

1. Title Page
2. Certificate from Guide
3. Acknowledgement
4. Abstract (max 300 words)
5. Table of Contents
6. Introduction
7. Objectives of the Study
8. Literature Review / Background
9. Problem Statement / Case Study Description
10. Methodology / Techniques Used / Field Observations
11. Analysis, Results, and Discussion
12. Conclusions and Recommendations
13. References (APA / IEEE style)
14. Appendices (if any)

Seminar Evaluation Criteria

1. Seminar Report

- Structure and formatting (Title page, index, references, etc.)
- Clarity of objectives and problem statement
- Quality and depth of literature review or background study
- Methodology or approach followed
- Analysis, observations, or findings from case studies
- Conclusions, recommendations, and originality/innovation

2. Oral Presentation

- Communication and presentation skills
- Depth of subject knowledge
- Use of visual aids (PowerPoint/other media)
- Handling of questions and audience interaction
- Confidence, fluency, and professionalism
- Effective time management

3. Overall Contribution and Conduct

- Regularity and punctuality in meetings and submissions
- Active participation and coordination with the guide
- Maintenance of logbook/diary
- Feedback from seminar guide or external/internal supervisor

Instructions for Students:

- Submit the proposed seminar topic in Week 1 of the semester.
- Attend all review meetings with your assigned guide.
- Weekly progress must be recorded and presented to the guide.
- Final seminar presentations to be conducted in Weeks 14–16 before a departmental panel.
- No plagiarism; originality will be checked and penalized if found otherwise.

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester III

Course Type: PROJ	**Lab Course Title:** Field Project	
Course Code: 240GSEM01_03	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 4	**Lecture (L): 0** **Tutorial (T): 0** **Practical (P):** 4 **Experiential Learning (EL): 8**	**Practical (P):** 50 Marks **Oral (OR):** 50 Marks

Prerequisite Courses, if any: -

Objectives:

- To identify, investigate and work on real-world industry problems.
- To develop skills in problem formulation, literature survey, methodology design, data collection, and analysis.
- To encourage independent thinking, research aptitude, and professional project documentation.
- To apply academic learning to practical engineering and management challenges.

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

CO1: Identify and define a researchable or practical problem in construction management.
CO2: Conduct an in-depth literature survey related to the topic.
CO3: Design a suitable methodology for field/project investigation.
CO4: Initiate data collection, modeling, or analysis.
CO5: Present findings and future scope effectively through a structured report and seminar.
CO6: Demonstrate time management, documentation, and communication skills.

Field Project Scope:

- Selection of problem/topic (based on industrial challenge, societal need, or academic relevance).
- Review of literature, background study, and framing of research/problem statement.
- Defining objectives, scope, and methodology.
- Preliminary data collection or case studies (if applicable).
- Submission of Project Proposal Report and Mid-Term Review Presentation.

Evaluation Criteria (Semester III - 100 Marks):

1. Problem Identification and Relevance
2. Literature Survey and Technical Understanding
3. Project Planning, Scope, and Methodology
4. Preliminary Work / Case Study / Field Work Progress
5. Regularity, Discipline, and Interaction with Guide
6. Mid-Semester and Final Presentation Skills
7. Documentation and Project Report

Instructions for Students (Phase I):

1. Topic Selection
   - Select a relevant, practical, or innovative topic in consultation with your assigned guide.
   - The topic may be industrial, societal, research-based, or field-oriented.
2. Proposal Preparation
   - Submit a project proposal including: problem statement, objectives, scope, review of literature, and proposed methodology.
3. Weekly Progress
   - Maintain regular contact with your internal guide (at least once a week).
   - Submit progress updates in your project logbook.
4. Mid-Semester Review
   - Present your progress in a departmental review to receive constructive feedback.
5. Interim Report Submission
   - Prepare a structured report containing proposal details, literature survey, initial work, methodology, and proposed data sources.
6. Plagiarism
   - Ensure your work is original and properly referenced. Plagiarism will result in rejection of report.
7. Final Presentation
   - Present your Phase I work before an evaluation panel and receive approval to proceed to Phase II.

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester III

Course Type: MLC	**Course Title**: Structural Audit	
Course Code: 230GSEM29_03	**Teaching Scheme:** (Hours. / Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):**	**Theory (TH):** 50 marks

Prerequisite Courses, if any:

1.

Course Objectives:

- To explain the concept, purpose, and legal framework of structural audits for civil infrastructure.
- To familiarize students with Non-Destructive Testing (NDT) techniques, evaluation methods, and their interpretation.
- To develop skills in detailed structural assessment, condition rating, and residual life estimation.
- To understand different components of GIS and Learning about map projection and coordinate system.
- Enhance professional competency in preparing structural audit reports, managing audits, and adhering to ethical practices.

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

CO1: Describe the need, objectives, and legal provisions related to structural audits in civil engineering.

CO2: Identify and classify different types of structural distress and their probable causes in RCC, steel, and masonry structures.

CO3: Select appropriate NDT techniques, conduct tests, and interpret results for assessing structural health.

CO4: Perform detailed structural assessments, evaluate condition ratings, and estimate the residual life of structures.

CO5: Propose suitable repair and retrofitting methods based on the nature and extent of distress.

CO6: Prepare comprehensive structural audit reports, incorporating technical findings, recommendations, and compliance with professional ethics.

Course Contents

Unit I	**Introduction to Structural Audit**	**(5 Hours)**

Concept & Importance of Structural Audit in civil infrastructure, Legal Provisions & Guidelines – National and International codes (IS 13311, IS 456, municipal requirements). Classification of Structures Requiring Audit – Residential, commercial, industrial, heritage. Stages of Structural Audit – Preliminary and detailed audit. Case examples of failures due to lack of timely audit.

Unit II	Distress in Structures: Causes & Identification	(5 Hours)
Types of structural distress – Cracks, corrosion, deflection, spalling, settlement, Causes – Material degradation, environmental effects, design faults, poor workmanship, overloading, Symptoms of Distress in RCC, steel, masonry structures, Visual inspection techniques – Checklist preparation Field photographs & video demonstrations.		
Unit III	**Non-Destructive Testing (NDT) & Evaluation Methods**	**(5 Hours)**
Types of structural distress – Cracks, corrosion, deflection, spalling, settlement, Causes – Material degradation, environmental effects, design faults, poor workmanship, overloading, Symptoms of Distress in RCC, steel, masonry structures, Visual inspection techniques – Checklist preparation, Field photographs & video demonstrations.		
Unit IV	**Detailed Structural Assessment & Condition Rating**	**(5 Hours)**
Preparation of structural drawings & documentation, Load assessment & design verification, Structural health grading & condition rating systems, Evaluation of residual life of structure, Reporting formats for structural audit.		
Unit V	**Repair & Retrofitting Techniques**	**(5 Hours)**
Principles of structural repair, Material selection – High performance concrete, FRP composites, polymer-modified mortars, strengthening methods – Jacketing, steel plate bonding, FRP wrapping, section enlargement, Foundation strengthening techniques, Waterproofing & corrosion protection, Standards & guidelines for repair execution.		
Unit VI	**Case Studies, Report Preparation & Audit Management**	**(5 Hours)**
Presentation of real-life structural audit case studies (RCC buildings, industrial sheds, bridges), Preparation of structural audit report – Executive summary, methodology, findings, recommendations, cost implications, Audit documentation for legal and municipal submission, Ethical considerations & professional responsibilities, Open discussion & Q&A session.		

JSPM University Pune

Faculty of Science and Technology

School of Civil and Environmental Sciences

NEP aligned Syllabus

for

M. Tech (Structural Engineering)

(Effective from AY: 2025-26)

	JSPM University Pune	**COURSE STRUCTURE (NEP 2020 Aligned)**	
	FACULTY OF SCIENCE & TECHNOLOGY	**W. E. F**	**2025-2026**
	SCHOOL OF CIVIL AND ENVIRONMENTAL SCIENCES	**RELEASE DATE**	**01/07/2025**
SECOND YEAR MASTER OF TECHNOLOGY (REGULAR) (STRUCTURAL ENGINEERING)		**REVISION NO.**	**1.0 (NEP)**

SEMESTER IV (LEVEL 7)

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS									
			Hours / Week				THEORY (Equal Weightage for CIE and ESE)				PRACTICAL (Equal Weightage for CIE and ESE)		ORAL (Equal Weightage for CIE and ESE)		TOTAL	CREDITS
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS INSEMESTER EVALUATION (100 Marks)			END SEMESTER EXAMINATION (100 / 50 marks)	CONTINUOUS INSEMESTER EVALUATION (50marks)	END SEMESTER EXAMINATION (50 marks)	CONTINUOUS INSEMESTER EVALUATION (50marks)	END SEMESTER EXAMINATION (50 marks)		
							T1 (30 Marks)	T2 (30 Marks)	Assign-ments (40 Marks)							
PEC	-	Program Elective-III/ MOOCs	3	-	-	-	30	30	40	100	-	-	-	-	100	3
PEC	-	Program Elective-IV/ MOOCs	3	-	-	-	30	30	40	100	-	-	-	-	100	3
PROJ	240GSEM02_04	Project/ Internship with Project	-	-	12	24	-	-	-	-	200	200	100	100	300	12
TOTAL			6	0	12	24									**500**	**18**
MLC#	-	Audit Course - II	1	-	-	-	-	-	-	50	-	-	-	-	50	1

Sem.	Programme Elective Course (PEC)				
	Specialization	**Structural Engineering**			
III (PEC – I)	**Course Code**	230GSEM08_03	230GSEM09_03	230GSEM10_03	230GSEM30_03
	Course Name	Theory of Plates and Shells	Theory of Elasticity and Plasticity	Advanced Design of Steel Structures	Seismology
III (PEC – II)	**Course Code**	230GSEM11_03	230GSEM12_03	230GSEM13_03	230GSEM31_31
	Course Name	Structural Health Monitoring and Retrofitting	Soil Structure Interaction	Stability Analysis of Slopes, Dams and Embankments	Geotechnical Earthquake Engineering
IV (PEC – III)	**Course Code**	230GSEM14_04	230GSEM15_04	230GSEM16_04	230GSEM32_04
	Course Name	Micro-Structure and Innovations in Structural Concrete	Advanced Concrete Technology and Applications	Prefabricated Structures	Design of Masonry Structures
IV (PEC – IV)	**Course Code**	230GSEM17_04	230GSEM18_04	230GSEM21_04	230GSEM33_04
	Course Name	Design of Substructure	Design of Tall Buildings	Design of Steel Concrete Composite Structures	Performance Based Seismic Design

Sem	Mandatory Learning Course (MLC#) - Audit Course	
III (Audit Course- I)	**Course Code**	230GSEM29_03
	Course Name	Structural Audit
IV (Audit Course- II)	**Course Code**	230UPOB02_04
	Course Name	Introduction to Indian Constitution

JSPM University Pune

S.Y. M.Tech. "Structural Engineering"

Semester- IV

Course Type: PEC - III	**Course Title:** Microstructure and Innovations in Structural Concrete	
Course Code: 230GSEM14_04	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

1. Strength of Materials.
2. Engineering Mechanics.

Course Objectives:

- To understand the microstructure of concrete and its influence on mechanical and durability properties.
- To explore advanced materials and innovative technologies in structural concrete.
- To analyze the performance and sustainability of novel concrete composites.

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

CO1: Demonstrate an understanding of the microstructural features of concrete and their influence on properties.

CO2: Apply advanced characterization techniques for microstructural analysis of concrete.

CO3: Compare and contrast the properties of high-performance and innovative concrete materials.

CO4: Evaluate innovative techniques for enhancing structural performance and durability of concrete.

CO5: Assess the durability and sustainability of advanced concrete mixes.

CO6: Integrate innovative materials and techniques in practical applications of structural concrete.

Course Contents

Unit I	**Introduction to Microstructure of Concrete**	**(6 Hours)**
Microstructural features, hydration process, pore structure, crystalline phases, ITZ in concrete.		
Unit II	**Characterization Techniques**	**(8 Hours)**
XRD, SEM, EDS, MIP, FTIR, Nanoindentation for concrete analysis.		
Unit III	**Advanced Concrete Materials**	**(10 Hours)**
HPC, self-healing concrete, UHPC, geopolymer concrete, fiber-reinforced concrete.		
Unit IV	**Innovations in Structural Concrete**	**(10 Hours)**
Nanomaterials, FRP, 3D printing in construction, recycled aggregates, self-sensing concrete.		
Unit V	**Performance Assessment and Durability**	**(6 Hours)**
Mechanical performance, durability issues, mitigation strategies, sustainability assessment.		

Unit VI	Case Studies and Practical Applications	(5 Hours)
Real-world applications, research trends, innovative construction techniques.		

Learning Resources
Text Books: 1. Concrete: Microstructure, Properties, and Materials: Mehta, P. K., & Monteiro, P. J. M. 2014. 2. Properties of Concrete: Neville, A. M. 2011. 3. Recent journal articles on innovative concrete technology.
MOOC / NPTEL Courses: 1.NPTEL Course https://onlinecourses.nptel.ac.in/noc24_ce104/preview

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: PEC - III	**Course Title:** Advanced Concrete Technology and Application	
Course Code: 230GSEM15_04	**Teaching Scheme:**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T): 0** **Practical (P): 0** **Experiential Learning (EL): 0**	**Theory (TH):** 100 Marks

Prerequisite Courses, if any:

1. Building Materials

Course Objective:

- To understand the various types of concrete and their ingredients
- To know various Deterioration process of concrete
- To understand the basic of additive manufacturing of concrete

Course Outcomes: At the end of course, Students will be able

CO1: To Demonstrate the standards, specifications, and properties of various concrete ingredients
CO2: To Identify and analyze the characteristics, applications, and benefits of advanced concrete
CO3: To Evaluate factors affecting the durability of concrete, including chemical attacks
CO4: To Investigate the use of waste materials and recycled aggregates in concrete production
CO5: To Assess the chemical durability and performance of specialized concrete types
CO6: To Analyze the challenges and methods involved in concreting under extreme conditions

Course Contents

Unit I	Concrete Science	(6Hrs)

Standards – specifications – Ingredients - cement and its types – Coarse Aggregate – Fine Aggregate. Chemical admixtures - Mineral admixtures - Polymer concrete - Mix design - Mix Design by IS: 10262-2019 - Mix Design by ACI: 312

Unit II	Concrete Types	(6Hrs)

Normal Vibrated Concrete - High volume fly ash concrete - High strength concrete – Reactive powder concrete & Oil well concrete - Ready mix concrete, pervious concrete.
Fiber Reinforced Concrete – FRP in concrete - Self compacting concrete – Bacterial Concrete – Self curing concrete - Geopolymer Concrete.

Unit III	Durability and fire hazards in concrete	(6Hrs)

Deterioration of concrete - Factors effecting the durability - Sulphate attack - Acid attack
Alkali Aggregate reaction – Carbonation – Abrasion - Freezing and Thawing - Corrosion of Rebar - Rapid Chloride penetration test

Unit IV	Use of waste materials in concrete	(6Hrs)
Waste from industry - Recycled aggregates – Sustainability Green concrete - Eco-Friendly Concrete		
Unit V	**Chemical Attack**	**(6Hrs)**
Chemical attack of concrete corrosion of steel rebars, other durability issues; Properties and applications of - High strength – high performance concrete, reactive powder concrete; Lightweight, heavyweight, and mass concrete		
Unit VI	**Special Concrete**	**(8Hrs)**
Tremie Method - Concrete in Cold weather - Concrete in Hot weather - miscellaneous topics, additive manufacturing of concrete (3D printing)		

Learning Resources

Books:

Textbooks:

1. Concrete Materials, Properties, Specification and Testing by S. Popovics, Standard Publishers, India
2. Properties of Concrete by A.M. Neville, ELBS Ed.

References:

1. Waste Materials in Concrete Manufacture by Satish Chandra, Indian Standard Publishers
2. Nondestructive Testing in Concrete by Bungey, Surrey University Press, London

MOOC / NPTEL Courses:

1. NPTEL https://nptel.ac.in/courses/105102012

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: PEC - III	**Course Title:** Prefabricated Structures	
Course Code: 230GSEM16_04	**Teaching Scheme:**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T): 0** **Practical (P): 0** **Experiential Learning (EL): 0**	**Theory (TH): 100 Marks**

Prerequisite Courses, if any:

Course Objective:

- To understand the principles, benefits, and challenges associated with prefabricated and modular construction methods.
- To gain knowledge on the design, detailing, production, and erection techniques of various prefabricated structural components.
- To analyze the behavior and performance of prefabricated structures under different loading conditions, including seismic and environmental forces.

Course Outcomes: At the end of course, Students will be able

CO1: To explain the fundamental concepts, types, and applications of prefabricated construction systems.

CO2: To classify and evaluate different structural systems and components used in prefabricated construction.

CO3: To apply design principles to develop structurally sound prefabricated systems considering stability, durability, and serviceability.

CO4: To design and detail appropriate joints and connections for prefabricated elements in compliance with standards and seismic requirements.

CO5: To assess various production methods, quality control measures, and erection techniques involved in prefabricated construction.

CO6: To analyze case studies and propose sustainable and cost-effective prefabricated solutions for real-life construction scenarios.

Course Contents

Unit I	**Introduction to Prefabrication**	**(7Hrs)**

Definition, need, scope, and benefits of prefabricated construction; Historical development and global trends; Classification and types of prefabricated systems (volumetric, panelized, hybrid, etc.); Modular coordination and standardization; Industrialized building systems; Advantages and limitations of prefabrication; Applications in residential, commercial, and infrastructure sectors

Unit II	**Structural Systems and Components**	**(8Hrs)**

Prefabricated load-bearing and non-load-bearing elements; Floor and roof systems: precast planks, hollow-core slabs, double tees; Wall panels: solid, sandwich, curtain wall; Frame systems: precast beams and columns; Staircase units, balconies, and parapets; Functional requirements of prefabricated structural elements; Case studies of typical prefabricated buildings		
Unit III	**Design Considerations**	**(7Hrs)**
Structural design principles for prefabricated systems; Load considerations and structural behavior under lateral loads; Stability and robustness in prefabricated buildings; Fire resistance, thermal insulation, acoustic; Seismic performance and design strategies for prefabricated buildings; Tolerances and joint detailing; Codes and standards (IS, Eurocodes, ACI, etc.)		
Unit IV	**Joints and Connections**	**(8Hrs)**
Types of joints: dry, wet, mechanical, and welded connections; Design of structural joints: ductility, strength, and durability; Moment-resisting and pin connections; Grouting techniques, dowel bars, shear keys, embedded parts; Connection detailing for seismic resilience; Construction tolerances and erection alignment; Examples of joint designs in precast frames and panels		
Unit V	**Production, Handling and Erection Techniques**	**(7Hrs)**
Factory production methods and quality control; Precasting yard layout, equipment, and curing techniques; Transportation, lifting, and storage of prefabricated components; On-site assembly techniques and crane planning; Safety considerations during lifting and erection; Speed, sequence, and logistics of construction; BIM and automation in prefabricated construction		
Unit VI	**Applications, Case Studies and Sustainability**	**(8Hrs)**
Prefabrication in high-rise buildings, affordable housing, and infrastructure; Case studies: Precast bridges, stadiums, industrial sheds; Sustainable aspects: reduction in construction waste, energy efficiency; Lifecycle cost analysis and carbon footprint; Comparison with conventional construction; Emerging technologies: 3D printing, precast sandwich panels, GFRP prefabs; Future trends and innovations		

Learning Resources

Books:

Textbooks:

1. Hass, A.M. – Precast Concrete: Structures, Properties and Production, CRC Press
2. Lewicki, B. – Prefabrication in Building Construction: A New Technology to Build Faster and Better, McGraw-Hill Education

References:

1. Koncz, J. – Manual of Precast Concrete Construction, Volumes I-III, Bauverlag GmbH
2. K.K. Chitkara – Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill (Chapters related to prefabrication logistics and management)

MOOC / NPTEL Courses:

1. NPTEL https://nptel.ac.in/

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: (PEC – II)	**Course Title:** Design of Masonry Structures	
Course Code: 230GSEM32_04	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: -

Course Objectives:

1. To develop an understanding of the material properties of masonry components and their influence on structural performance.
2. To analyze the behavior of masonry under axial and lateral loads, including compression, shear, and flexure.
3. To apply design methodologies for load-bearing and infill masonry using relevant codes and standards.
4. To enable students to carry out the structural design of masonry walls and systems considering real-world loading and performance requirements.

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

CO1: Interpret the evolution, applications, and current standards of masonry construction at national and international levels.
CO2: Evaluate the mechanical and physical properties of masonry materials including bricks, blocks, mortar, grout, and reinforcement, and understand their influence on structural behavior.
CO3: Analyze masonry structures subjected to axial compression, eccentric loading, and determine design parameters such as prism strength and kern distance.
CO4: Assess the behavior of masonry walls under lateral forces, including in-plane and out-of-plane actions, and perform analysis of perforated shear walls using diaphragm assumptions.
CO5: Examine the structural response of both reinforced and unreinforced masonry under complex loading.
CO6: Design load-bearing and infill masonry structures using both working stress and limit state design approaches.

Course Contents

Unit I	Introduction	5 Hrs

Masonry construction - National and International perspective - Historical development, Modern masonry, Principles of masonry design, Masonry standards: IS 1905 and others.

Unit II	Material Properties	8 Hrs

Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns,

Shrinkage and differential movements.		
Unit III	**Masonry in Compression**	**7 Hrs**
Prism strength, Eccentric loading, Kern distance.		
Unit IV	**Masonry under Lateral loads**	**8 Hrs**
In-plane and out-of-plane loads, Analysis of perforated shear walls, Lateral force distribution - flexible and rigid diaphragms.		
Unit V	**Behaviour of Masonry**	**8 Hrs**
Shear and flexure - Combined bending and axial loads - Reinforced and unreinforced masonry - Cyclic loading and ductility of shear walls for seismic design - Infill masonry.		
Unit VI	**Structural design of Masonry**	**9 Hrs**
Working and Ultimate strength design - In-plane and out-of-plane design criteria for load bearing and infills, connecting elements and ties - Consideration of seismic loads – Code provisions.		

Learning Resources

Text Books:

1. Dayaratnam, P and P. Sarah, Brick and Reinforced Brick Structures Medtech Publishing, 2017, 2nd Edition.
2. Drysdale, R. G. Hamid, A. H. and Baker, L. R, The Masonry Structures: Behaviour& Design, Masonry Society,1999, 2nd Edition.

Reference Books:

1. K S Jagadish, Structural Masonry, Wiley Publishing, 2019.
2. Narendra Taly, Design of Reinforced Masonry Structures, Tata McGraw Hill, 2010, 2nd Edition.
3. A.W. Hendry, B.P. Sinha and Davis, S. R, Design of Masonry Structures, CRC Press, 2017, 3rd Edition.

MOOC / NPTEL Courses:

NPTEL Course, “Design of Masonry Structures”, by Prof. Arun Menon, IIT Madras
https://nptel.ac.in/courses/105106197

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F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: (PEC – IV)	**Course Title:** Design of Substructures	
Course Code: 230GSEM17_04	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: -

1. Foundation Engineering
2. Geotechnical Engineering
3. Advanced Concrete Technology
4. Structural Design
5. Soil-Structure Interaction

Course Objectives:

- Understand the design philosophies and performance criteria of substructures.
- Develop competence in analysis and design of various shallow and deep foundation systems.
- Explore soil-structure interaction and its impact on substructure behavior.
- Learn about advanced and special foundation systems including seismic considerations.
- Apply design codes and standards relevant to practical substructure engineering.

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

CO1: Interpret subsurface investigation reports and choose suitable foundation types.
CO2: Analyze and design shallow and deep foundations using IS codes.
CO3: Design pile groups, pile caps, and well foundations for various structures.
CO4: Apply soil-structure interaction concepts to practical foundation problems.
CO5: Evaluate and design retaining structures and basement systems.
CO6: Implement special techniques for problematic soils and seismic foundation design.

Course Contents

Unit I	Introduction to Substructure Systems	7 Hrs

Definition, classification, and performance of substructures, Geotechnical investigations: types, methods, and interpretation, Design philosophies: working stress, limit state, and performance-based design, Soil-structure interaction and failure mechanisms in foundations.

Unit II	Shallow Foundations	8 Hrs

Types of shallow foundations: isolated, combined, strip, raft, Bearing capacity theories (Terzaghi, Meyerhof), settlement analysis, Structural design of footings as per IS 456 and IS 1904, Design of mat and raft foundations.

Unit III	Deep Foundations: Piles and Pile Caps	7 Hrs

Classification and types of piles, design loads, pile load tests, Design of single and group piles using

IS 2911, Group action and interaction effects, Design of pile caps using IS codes.		
Unit IV	**Caisson and Well Foundations**	**8 Hrs**
Applications in bridge and marine works,Types: open, pneumatic, box caissons, Construction techniques, scour depth, and stability analysis, Design considerations per IRC and IS codes.		
Unit V	**Retaining Walls and Basement Structures**	**7 Hrs**
Earth pressure theories: Rankine and Coulomb, Design of cantilever and counterfort retaining walls, Basement design: waterproofing, uplift, and lateral pressure, Reinforced earth retaining structures.		
Unit VI	**Special Topics in Substructure Design**	**8 Hrs**
Foundations on problematic soils (expansive, collapsible),Soil improvement techniques (grouting, compaction, etc.), Seismic design of foundations (IS 1893 & IS 13920), Dynamic loading and machine foundation basics, Case studies on foundation failures and retrofitting.		

Learning Resources

Text Books:

1. Bowles, J.E. – *Foundation Analysis and Design*, McGraw-Hill.
2. Tomlinson, M.J. – *Foundation Design and Construction*, Pearson Education.

Reference Books:

1. Das, B.M. – *Principles of Foundation Engineering*, Cengage.
2. Poulos & Davis – *Pile Foundation Analysis and Design*.
3. Swami Saran – *Soil Dynamics and Machine Foundations*, Galgotia.
4. Teng, W.C. – *Foundation Design*, Prentice Hall.

MOOC / NPTEL Courses:

1. *Foundation Engineering* – NPTEL (Prof. B.V.S. Viswanadham, IIT Bombay)
2. *Soil-Structure Interaction* – NPTEL
3. *Geotechnical Earthquake Engineering* – NPTEL

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F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: (PEC – IV)	**Course Title:** Design of Tall Buildings	
Course Code: 230GSEM18_04	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: -

1. Structural Analysis
2. Design of Concrete Structures
3. Design of Steel Structures
4. Structural Dynamics

Course Objectives:

5. To provide students with a comprehensive understanding of the fundamental principles and design philosophies of tall buildings.
6. To make students Analyze and design structures to resist gravity, wind, and seismic loads.
7. To make students explore serviceability, sustainability, and durability aspects in high-rise construction.
8. To Introduce advance seismic design methods such as the Performance-Based Design concept.

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

CO1: Classify structural systems for tall buildings and assess their applications based on functionality and design requirements.
CO2: Calculate vertical and lateral loads (wind, seismic, and gravity) acting on tall structures using applicable codes and standards.
CO3: Perform structural analysis, and design for wind loading.
CO4: Understand with limitations of force-based codal method of design and the need for performance- based design.
CO5: Understand the various performance evaluation criteria and the various nonlinear analyses.
CO6: Design RC frame buildings incorporating drift and performance level.

Course Contents

Unit I	Introduction to Tall Buildings	7 Hrs

Definition and Importance: Characteristics of tall buildings, historical evolution, and architectural considerations, Classification: Types based on usage, structural systems, and height, Basic Design Principles: Overview of functional planning, zoning, and design standards, Environmental Considerations: Impact of climate, wind, and seismic forces.

Unit II	Structural Systems and Materials	8 Hrs

Structural Systems: Rigid frames, braced frames, shear walls, and tube systems, Core and outrigger systems, Material Selection: High-strength concrete and steel, Use of composites and innovative materials in tall buildings, Load Considerations: Dead loads, live loads, wind loads, and seismic loads, Creep and Shrinkage Effects: Influence on the design of tall buildings, Temperature Effects: Impact of temperature variations on materials and structural performance.		
Unit III	**Design for Wind Loads**	**8 Hrs**
Vertical Load Systems: Column, wall, and core contributions, Lateral Load Design: Wind forces: Dynamic effects and vortex shedding,		
Unit IV	**Seismic Design**	**7 Hrs**
Introduction to Tall building behavior during earthquakes and seismic design philosophy.		
Unit V	**Performance-Based Seismic Design**	**8 Hrs**
Introduction to Performance Based Seismic Design, Performance levels – Immediate Occupancy Level, Life Safety Level, Collapse Prevention Level; The concept of Capacity Design. Capacity design applied to buildings; Nonlinear Analyses		
Unit VI	**Modelling for analysis**	**7 Hrs**
Approaches for analysis, Assumptions involved in modeling, Reduction techniques, Application using Structural engineering Software.		

Learning Resources

Text Books:

1. Bryan Stafford Smith & Alex Coull, "Tall Building Structures: Analysis and Design," Wiley-Interscience, First Edition.
2. Bungale S. Taranath, "Structural Analysis and Design of Tall Buildings," CRC Press, Second Edition.
3. Feng Fu, Design and analysis of Tall and Complex Structures, Butterwoth Heinemann, 2018.

Reference Books:

1. Jack C. McCormac, "Design of Reinforced Concrete," Wiley, Ninth Edition.
2. Devdas Menon, "Advanced Structural Analysis," Narosa Publishing House, First Edition.

MOOC / NPTEL Courses:

1. Design of Tall Buildings by Fawad A. Nazam, Course offered by Asian Institute of Technology, Thailand
2. Tall Buildings: Structural Systems and Design
   Platform: edX (offered by CTBUH or a similar provider)
   Description: An advanced course covering design philosophies, structural systems, and sustainability.
3. Building Design for Wind Forces (Coursera or edX)
   Platform: edX (offered by CTBUH or a similar provider)
   Description: Focuses on designing buildings to resist wind forces, crucial for tall buildings.

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F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: PEC -IV	**Course Title:** Design of Steel Concrete Composite Structures	
Course Code: 230GSEM21_04	**Teaching Scheme:**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T): 0** **Practical (P): 0** **Experiential Learning (EL): 0**	**Theory (TH): 100 Marks**

Prerequisite Courses, if any:

1.

Course Objective:

- To introduce the principles and behavior of steel-concrete composite structures.
- To provide design methodologies for composite beams, columns, slabs, and connections using relevant standards.
- To develop the ability to analyze, design, and detail safe and efficient composite systems for buildings and bridges.

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

CO1: To explain the fundamental concepts and advantages of steel-concrete composite structures.
CO2: To analyze and design composite beams, slabs, and columns as per IS and international codes.
CO3: To evaluate the behavior of shear connectors and their influence on composite action.
CO4: To design efficient composite connections for structural integrity and seismic performance.
CO5: To apply design principles in developing composite structures for buildings and bridges.
CO6: To assess the structural and economic benefits of composite construction through case studies and advanced applications.

Course Contents

Unit I	Introduction to Composite Construction	(6Hrs)

Introduction and comparison with conventional steel and concrete structures; Advantages of composite construction: strength, stiffness, economy; Types of composite construction: slab-beam, column-beam, trusses; Concept of partial and full interaction; Materials used in composite construction; Basic codal provisions (IS 11384, IS 800, Eurocode 4)

Unit II	Composite Slabs and Beams	(6Hrs)

Types of composite slabs, profiled sheeting; Load transfer mechanism between slab and steel beam; Design of composite beams (simply supported and continuous); Shear connectors: types, functions, and design; Degree of interaction, ultimate strength and serviceability checks; IS 11384, IS 800 (Limit State Design)

Unit III	Composite Columns and Frames	(6Hrs)
Types of composite columns: encased, in-filled, and partially encased; Axial and biaxial loading in composite columns; Slenderness effects and buckling behavior; Design of composite columns as per IS 11384 and Eurocode 4; Composite frames: behavior, modeling, and applications; Interaction diagrams and design charts		
Unit IV	**Connections in Composite Structures**	**(6Hrs)**
Classification of connections: simple, moment-resisting; Detailing and design of bolted and welded joints; Seismic detailing for composite connections; Stud connectors: behavior, spacing, and failure modes; Connections in composite floors and frames; Ductility and energy dissipation		
Unit V	**Design of Composite Bridges**	**(6Hrs)**
Introduction to composite bridge decks; Typical cross-sections and structural systems; Design of composite girders and slab systems; Shear lag effects, differential shrinkage and creep; Temperature effects and expansion joints; Case studies of steel-concrete composite bridges		
Unit VI	**Advanced Topics and Applications**	**(8Hrs)**
Fire resistance and durability of composite structures; Vibration and serviceability considerations; Construction practices, erection techniques, and safety; Introduction to Precast Composite Construction; Case studies of multistory buildings and high-rise towers; Software tools (ETABS, SAP2000, MIDAS) for composite design		

Learning Resources

Books:

Textbooks:

1. Johnson, R. P. – Composite Structures of Steel and Concrete, Wiley-Blackwell
2. Oehlers, D. J. and Bradford, M. A. – Composite Steel and Concrete Structural Members: Fundamental Behaviour, Elsevier

References:

1. N. Subramanian – Design of Steel Structures, Oxford University Press (Chapters on composite construction)
2. IS:11384-2022 – Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards.

MOOC / NPTEL Courses:

1. NPTEL https://archive.nptel.ac.in/courses/112/104/112104229/

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F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: (PEC – IV)	**Course Title:** Performance-Based Seismic Design	
Course Code: 230GSEM33_04	**Teaching Scheme:** (Hrs. / Week)	**Examination Scheme:**
Credits: 3	**Lecture (L):** 3 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 100 Marks

Prerequisite Courses, if any: -

1. Structural Analysis
2. Design of Concrete Structures
3. Design of Steel Structures
4. Structural Dynamics
5. Earthquake Resistant Design of Structures

Course Objectives:

1. To develop an understanding of the limitations of force-based codal design methods and the necessity for performance-based design.
2. Learn to design structures to meet specified target performance criteria under a given seismic hazard level.
3. Apply drift-based and performance-level criteria in the seismic design of frame buildings, frame–wall buildings, and other structural systems.
4. To apply Performance-Based Design in practical designs.
5. To Develop interest in pursuing higher studies in displacement-based seismic design and foster a commitment to lifelong learning.

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

CO1: Understand the evolution of seismic design philosophies, with emphasis on the limitations of conventional force-based seismic design approaches.
CO2: Develop a clear understanding of ground motion characteristics, response spectra, and key seismic design parameters influencing structural performance.
CO3: Comprehend the fundamentals of performance-based seismic design (PBSD) and define appropriate performance objectives for buildings.
CO4: Apply nonlinear modeling techniques and advanced seismic analysis methods to realistically assess structural behavior under earthquakes.
CO5: Understand and apply displacement-based seismic design principles for achieving target performance levels.
CO6: Critically evaluate and apply unified performance-based seismic design methodologies for reinforced concrete frame buildings.

Course Contents		
Unit I	**Force-Based Seismic Design**	**7 Hrs**
Force-based method of design, Historical development. Limitations of Force-based method of design. Limitations of IS 1893 (Part 1)-2016. Moment-curvature relationship, Strength- Stiffness relationship; Types of strengths - Expected strength, characteristic strength, extreme strength;		
Unit II	**Ground Motion and Design Parameters**	**7 Hrs**
Spectrum Compatible Ground Motions. Review of Response Spectrum Method of Design. Displacement Spectra. The concept of Capacity Design. Capacity design applied to buildings and other structures.		
Unit III	**Performance-Based Design**	**8 Hrs**
Introduction to Performance-Based Design phylosophy; Force-based method of design vs. Performance-based method of design; The concept of Operational Level Buildings. Multi-objective design. Performance levels – Immediate Occupancy Level, Life Safety Level, Collapse Prevention Level. Drift in buildings and design for drift. Design for desired performance objectives.		
Unit IV	**Nonlinear Modelling and Analysis**	**7 Hrs**
Nonlinear modelling- Hinges, Nonlinear Analyses- POA and NLTHA		
Unit V	**Direct Displacement-Based Seismic Design**	**8 Hrs**
Displacement-based design philosophy. Direct Displacement-based design methods for frame buildings		
Unit VI	**Unified Performance-Based Seismic Design**	**8 Hrs**
Unified Performance-based Design Method for frame buildings		

Learning Resources

Text Books:

1. Choudhury Satyabrata, "Performance-Based Seismic Design of Structures," CRC Press.
2. Jain A.K, "Dynamics of Structures with MATLAB Applications," Pearson India Education Services Pvt. Ltd.

Reference Books:

1. Priestley M.J.N., Calvi G.M. and Kowalasky M.J., "Displacement-Based Seismic Design of Structures"
2. Seismic Evaluation and Retrofit of Concrete Buildings, ATC-40.

MOOC / NPTEL Courses:

1. Performance-Based Seismic Design of Structures by Prof. Satyabrata Choudhury

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F.Y. M. Tech "Structural Engineering"

Semester IV

Course Type: PROJ	**Lab Course Title:** Project	
Course Code: 240GSEM02_04	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 12	**Lecture (L):** **Tutorial (T):** **Practical (P):** 12 **Experiential Learning (EL):** 24	**Practical (P):** 200 Marks **Oral (OR):** 100 Marks

Prerequisite Courses, if any: -

Objectives:

- To carry out in-depth field or technical investigation leading to solutions or recommendations.
- To validate methodology and refine approach through real-time analysis.
- To prepare for professional or research roles by developing complete project execution and communication skills.

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

CO1: Implement the methodology developed in Phase I.
CO2: Perform advanced analysis, modeling, or empirical study.
CO3: Interpret data and derive meaningful conclusions or insights.
CO4: Recommend practical solutions, strategies, or innovations.
CO5: Demonstrate professional reporting and presentation skills.
CO6: Exhibit teamwork, time management, and ethical standards.

Project Scope:

- Full-scale execution of field study/project/research.
- Data analysis, model testing, simulations (if applicable).
- Derivation of results, conclusions, and recommendations.
- Report writing in dissertation format.
- Final Seminar and Viva Voce.

Evaluation Criteria (Semester IV - 200 Marks):

1. Problem Definition and Continuity from Phase I
2. Execution of Methodology / Field Work / Simulation
3. Quality of Analysis, Interpretation, and Originality
4. Use of Tools, Software, or Data Modelling (if applicable)
5. Professional Project Report / Thesis Formatting
6. Interim Review Presentations
7. Final Seminar and Viva Voce
8. Discipline, Timeliness, Guide Feedback & Logbook

Instructions for Students (Phase II):

1. Work Execution
   - Carry out planned methodology including data collection, field visits, experiments, or case studies.
   - Use relevant tools, software, or modelling techniques as required.
2. Weekly Guidance & Reporting
   - Continue weekly updates to your guide and maintain project logbook.
   - Follow timelines and meet interim milestones.
3. Project Documentation
   - Your final report should include:
     - Cover Page
     - Abstract
     - Introduction
     - Literature Review
     - Methodology
     - Data Collection & Analysis
     - Results, Inferences, and Recommendations
     - Conclusion
     - References and Appendices
     - Plagiarism Check Certificate
4. Interim Review
   - Participate in mid-semester internal review to showcase progress and receive guidance.
5. Final Viva Voce
   - Present your complete project before the evaluation committee.
   - Answer queries based on your project's technical and practical aspects.
6. Professional Conduct
   - Ensure punctuality, discipline, ethical research practices, and regular communication with your guide.

JSPM University Pune

F.Y. M. Tech "Structural Engineering"

Semester- IV

Course Type: MLC	**Course Title:** Introduction to Indian Constitution	
Course Code: 230UPOB02_04	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks

Prerequisite Courses, if any: Nil

Course Objectives:

- To understand the historical context and constitutional development of India, including the impact of the colonial legacy and the role of the Constituent Assembly.
- To analyse the core principles of the Indian Constitution, including the Preamble, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, and their interrelationships.
- To examine the structure of the Indian government, the process of constitutional amendments, and the role of judicial review in upholding constitutional principles.

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

CO1: Remember- Recall the historical background, key events, and figures involved in the constitutional development of India.

CO2: Understand- Explain the significance of the Preamble and the fundamental principles of the Indian Constitution, such as sovereignty, secularism, socialism, and democracy.

CO3: Apply- Demonstrate an understanding of Fundamental Rights and Duties by identifying their applications and limitations in real-world scenarios.

CO4: Analyse- Analyse the relationship between Fundamental Rights and Directive Principles of State Policy, and how they interact to shape governance in India.

CO5: Evaluate- Assess the effectiveness of significant constitutional amendments and the role of judicial review in maintaining the integrity of the Indian Constitution.

CO6: Create- Develop a coherent argument or proposal for a constitutional amendment or policy change, grounded in the principles and structure of the Indian Constitution.

Course Contents		
Unit I	**Historical background**	**(3 Hrs)**
Colonial legacy, Constitutional development, The constituent assembly		
Unit II	**Preamble and fundamental principles**	**(2 Hrs)**
The Preamble, Sovereignty, Secularism, Socialism, and Democracy, Justice, Liberty, Equality, and Fraternity		
Unit III	**Fundamental Rights and Duties**	**(3 Hrs)**
Fundamental rights, Fundamental duties, Restrictions and amendments		

Unit IV	**Directive Principles of State Policy**	**(3 Hrs)**
Definition and purpose, Classification, Relationship with fundamental rights		
Unit V	**Organs of the Government**	**(2 Hrs)**
Union and state governments, The President and Prime minister, Parliamentary system		
Unit VI	**Amendments and Judicial Review**	**(2 Hrs)**
Amendment process, Significant amendments, Judicial review		

Learning Resources

Textbooks:

1. Basu, D. D., *Introduction to Constitution of India*, Prentice Hall of India, 1989
2. M. P. Jain, Indian Constitutional Law, LexisNexis, 2020

Reference Books:

1. Granville Austin The Indian Constitution: Cornerstone of a Nation, Oxford University Press, 1966
2. Mahendra Pal Singh, Shukla's Constitution of India, Eastern Book Company, 2019
3. Rajani Goyal, Modern Constitutions, RBSA Publications, 2023
4. Sukhbir Bhatnagar, Constitutional Law and the Governance, Mittal Publications, 2008

MOOC / NPTEL Courses:

1. Swayam: Constitutional Law **Link of the Course:** Constitutional Law, Aneeda Jan

Additional Web Resources: Constitution of India