PG-Curriculum

(Structure and Course Contents)

Structural Engineering

with effect from 2022-23 session

EXPLORE INNOVATE EXCEL

Civil Engineering Department

Punjab Engineering College

(Deemed to be University)

Chandigarh

Proposed Semester Wise PG Scheme to be implemented w.e.f. 2022-23 session

Semester I		
S. No.	**Courses**	**Credits**
1	**Engineering Mathematics**	**3**
2	**PCC-I**	**3**
3	**PCC-II**	**3**
4	**PCC-III**	**3**
5	**PEC-I**	**3**
6	**Soft-Computing/Soft Skills and Management**	**3**
	Total	**18**

Semester II		
S. No.	**Courses**	**Credits**
1	**PCC-IV**	**3**
2	**PCC-V**	**3**
3	**PCC-VI**	**3**
4	**PEC-II**	**3**
5	**Open Elective-I**	**3**
6	**Industrial Tour**	**0**
7	**Design of Experiments and Research Methodology**	**3**
	Total	**18**

Semester III		
S. No.	**Courses**	**Credits**
1	**Seminar and Report Writing**	**2**
2	**Research and Publication Ethics**	**2**
3	**Dissertation-I**	**14**
	Total	**18**

Semester IV		
S. No.	**Courses**	**Credits**
1	**Dissertation-II**	**18**
	Total	**18**

Total Credits = 18 + 18 + 18 + 18 = 72

PG Curriculum Structure

Sr. No.	Course Stream & Course Code	Course Name	Credits
Semester I			
1	Engineering Mathematics	Engineering Mathematics	3
2	Program Core Course (PCC-I) **STR1101**	Advanced Structural Analysis	3
3	Program Core Course (PCC-II) **STR1102**	Structural Dynamics	3
4	Program Core Course (PCC-III) **STR1103**	Advanced Reinforced Concrete Structures	3
5	Program Elective Course (PEC-I)		
	STR1201	Advanced Concrete Technology	3
	STR1202	Advanced Foundation Engineering	3
	STR1203	Seismic Resistant Design of Structures	3
	STR1204	Liquid Retaining Structures	3
6	**SCR 1001**	Soft-Computing	3
	SMR 1001	Soft Skills and Management	3
Total Credits			**18**

Sr. No.	Course Stream & Course Code	Course Name	Credits
		Semester II	
1	Program Core Course (PCC-IV) **STR1104**	Pre-Stressed Concrete Structures	3
2	Program Core Course (PCC-V) **STR1105**	Advanced Steel Structures	3
3	Program Core Course (PCC-VI) **STR1106**	Bridge Engineering	3
4	Program Elective Course (PEC-II) **STR1251** **STR1252** **STR1253** **STR1254** **STR1255**	 Plated and Shell Structures Finite Element Method in Civil Engineering Health Monitoring and Retrofitting of Structures High Rise Buildings Building Services	3
5	Open Elective –I **STR3001** **STR3002**	• Health Monitoring and Retrofitting of Structures • Building Services	3
6	Industrial Tour **STR4001**	Industrial Tour	0
7	Research Methodology **STR1001**	Design of Experiments and Research Methodology	3
		Total Credits	**18**

Sr. No.	Course Stream & Course Code	Course Name	Credits
Semester III			
1	Seminar and Report writing **STR5001**	Seminar and Report writing	2
2	Research and Publication Ethics **RPR6001**	Research and Publication Ethics	2
3	Dissertation – I **STR7001**	Dissertation - I	14
Total Credits			**18**

Sr. No.	Course Stream & Course Code	Course Name	Credits
Semester IV			
1	Dissertation – II **STR8001**	Dissertation - II	18
Total Credits			**18**

Note:

1. **Industrial Tour will be held in winter vacation after 1st semester and it will be recorded in 2nd Semester.**

2. **In the First and Second Semester, at least one of the Department Core Courses should have laboratory component.**

SEMESTER I

Course Name	:	**Advanced Structural Analysis PCC-I**
Course Code	:	**STR1101**
Credits	:	**3**
L T P	:	**3-0-0**

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To learn advanced methods of structural analysis and to apply these methods for analysis of indeterminate structures.
2.	To impart preliminary knowledge of analysing structures using finite element method.

Course Contents:

S. No.	Course Contents	No. of Lectures
1	**Stiffness Matrix Method:** Basis of stiffness method, Influence coefficients, Kinematic indeterminacy, Degree of freedom, Action displacement relationship, Matrix approach to stiffness method, Transformation of axes system, Formation of load vectors.	**6**
2	**Application of stiffness matrix method:** Application of stiffness matrix method to various type of structures e.g., Continuous beams, Trusses, Frames and grids, partially discontinuous structures, yielding of supports, spring supports, Temperature effects.	**14**
3	**Flexibility Matrix Method*:*** Compatibility equations, Flexibility coefficients, Application of complimentary energy principles, Basis of the method, Application of flexibility matrix method to various types of structures: continuous beams, trusses and frames.	**8**
4	**Finite Element Method*:*** Introduction to finite element method, Theory of elasticity, Coordinate systems, Rotation of axes, Shape functions, Serendipity, Lagrange and Hermitian family of elements, rectangular elements in flexure, rectangular element in plane stress and bending, Triangular elements in plane stress and strain, Elements stiffness matrix and load vector, Numerical integration, Isoparametric elements, Computer programming concepts.	**14**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Determine indeterminacy of the framed structures.
2.	Evaluate the framed structures using matrix approach.
3.	Analyse the complex structures using advanced methods of analysis.
4.	Apply the basic concept of finite element method for analysis of civil engineering structures.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1	Gere and Weaver, "Matrix Analysis of Framed Structures", CBS Publishers	2012
2	Wang C.K., "Analysis of Indeterminate Structures", Mc Graw Hill	1982
3	Desai C.S., "Introduction to Finite Element Method", CBS Publisher	1998
4	Jain A.K., "Advance Structural Analysis", Nem Chand & Bros.	2015
5	Relevant IS codes (Latest Revision)	

Classical Books:

S. No.	Name of Book/Authors/Publisher	Year of Publication/Reprint
1	Zeiekiwitz and Cheung, "Finite Element Methods", Tata McGraw Hill Publishing, Pvt. Ltd.	1967
2	Pei Chi Chou, "Elasticity, Tensor, Dyadic and Engg Approache", University Series in Basic Engineering	1967

MOOCs on this course are available at:

1. https://nptel.ac.in/courses/105106050/
   By Prof. Devdas Menon, Indian Institute of Technology, Madras

2. https://www.civilax.com/lectures-advanced-structural-analysis/
   By Dr. Shahzad Rahmad, University of Engineering and Technology, Peshawar

	PO1	PO2	PO3	PO4
CO1	3	2	3	2
CO2	3	2	2	3
CO3	3	3	3	2
CO4	3	2	3	3
Target PO	3	2.25	2.75	2.5

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	**:**	**Structural Dynamics**	**PCC-II**
Course Code	**:**	**STR1102**	
Credits	**:**	**3**	
L T P	**:**	**3-0-0**	

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To impart the knowledge of dynamic response of structures.
2.	To illustrate applications of the structural dynamics theory for practical problems.
3.	Ability to apply structural dynamic theory to real world problems.
4.	To impart knowledge basics of Machine Foundations.

Course Contents:

S. No.	Course Contents:	No. of Lectures
1.	**Single Degree of Freedom Systems:** Fundamental, Mass spring damper system, Analysis of free vibrations, Types of dynamic loading, Response to harmonic loading, periodic loading, Impulsive loading and general dynamic loading.	**7**
2.	**Multi Degree of Freedom Systems:** Two degree of freedom system – undamped, free & forced. Multidegree of freedom system- undamped, Hozler's method, Stodola's method, Orthogonality condition, Damped system. Dynamic analysis and Response- Modal Analysis, Response spectrum analysis.	**10**
3.	**Structures with Distributed Mass and Load***:* Axial, shear and transverse vibration due to bending of beams, Uniform shear beam, Beam in bending, Numerical techniques for shear beam, Bending of beams.	**8**
4.	**Earthquake Motion and Response***:* Introduction, Seismology, Strong motion earthquake, Elastic spectra, Ground velocity and displacement, Inelastic spectra.	**5**
5.	**Introduction to IS 1893 and IS 13920:** Seismic analysis and design of framed structures by equivalent lateral load procedure and dynamic analysis, Introduction to Ductile Detailing of Structures, Concept of Soft Story, Torsional rigidity and Structural Irregularities.	**7**
6.	**Machine Foundations***:* Introduction to Design of machine foundations.	**5**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Evaluate the dynamic properties of SDOF and MDOF systems subjected to different kinds of loadings and carry out response- modal and response spectrum analysis.
2.	Carry out the dynamic analysis of structures with distributed mass and loads.

3.	Evaluate seismic load for a building using equivalent static load method, dynamic analysis, perform ductile detailing of buildings as per relevant IS codes.
4.	Understand the concepts involved in and carry out the design of machine foundations.

Bibliography:

S.No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Krishna Jai, "Elements of Earthquake Engineering", South Asian Publishers, New Delhi	2014
2.	Dowrick, "Earthquake Resistant Design", Wiley Interscience Publication, New Jersey	2009
3.	Chopra K. Anil., "Dynamics of structures", Pearson Education Limited, London	2016
4.	Clough and Penzein, "Dynamic of Structures", McGraw Hill Education, New York	2003
5.	Paz Mario, "Structural Dynamics Theory & Computation - Theory and Computation", CBS Publishers & Distributors	2004
6.	S. K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press	2007
7	Relevant IS codes (Latest Revision)	

Classical Books:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	John's Biggs, "Dynamics of Structures", McGraw Hill Publications, New York	1965

MOOCs on this course are available at:

1. https://swayam.gov.in/course/3697-structural-dynamics
   By Prof. Ramancharala Pradeep Kumar, IIIT Hyderabad
2. http://nptel.ac.in/courses/105101006/
   By Prof. P. Banerji, IIT Bombay
3. https://freevideolectures.com/course/3129/structural-dynamics

	PO1	PO2	PO3	PO4
CO1	3	3	2	3
CO2	3	2	2	2
CO3	3	2	3	3
CO4	3	2	1	2
Target PO	3	2.25	2	2.5

1 – Slight (Low) Correlation, 2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation , "-" indicates there is no correlation.

Course Name	:	**Advanced Reinforced Concrete Structures PCC-III**
Course Code	:	**STR1103**
Credits	:	**3**
L T P	:	**2-0-2**

Total No. of Lectures: 28

Total No. of Lab Hours: 28

Course Objectives:

The main objectives of the course are:	
1.	To enhance competence in design of advanced reinforced concrete structures.
2.	To familiarize the students with the concepts of designing concrete mixes using different methods of proportioning and to understand the effects of various parameters.

Course Contents:

S. No.	Course Contents	No. of Lectures
1.	**Concrete Technology:** Concrete as structural material, strength of concrete and its significance, Strength porosity relationship, Factors affecting compressive strength, Behaviour of concrete under stress states, Durability of concrete and its significance, Chloride and Sulphate attack, Alkali aggregate reaction, Carbonation, Corrosion of embedded steel in concrete and concrete deterioration due to corrosion of steel and its preventive measures.	**5**
2.	**Design of Slender Columns:** Concentrically loaded slender columns, eccentrically loaded slender columns, slender columns subjected to axial and transverse loads, Structural behaviour of columns in braced and unbraced frames, Codal procedure for design of slender columns. Design of Beam Column Joints, Anchorage requirement in joints and detailing of reinforcement in joints.	**4**
3.	**Flat Slabs:** Elements of flat slabs, Codal procedure for design of flat slabs, Behaviour of flat slab in shear, One way and two-way shear, Equivalent Frame Method, Openings in flat slabs, Effect of pattern loading in flat slabs.	**5**
4.	**Deep Beams**: General features, Parameter influencing design, Flexuralbending and shear stresses in deep beams. Design provisions of IS-456, Checking for local failures, Strut and tie analysis of deep beams,Detailing of reinforcement in deep beams.	**5**
5.	**Yield Line Analysis*:*** Design of slabs of various shapes and having various support conditions using yield line analysis approach.	**4**
6.	**Liquid Retaining Structures:** design concepts for liquid retaining structures, design of ground supported tanks, design of underground tanks, design procedure of Intze type overhead service reservoir.	**5**

Lab Work:

S. No.	Lab contents	No. of Hours
1.	Effect of water/cement ratio on workability and strength of concrete	**04**
2.	Effect of fine aggregate/coarse aggregate ratio on strength and permeability of concrete.	**04**
3.	Study of Mix Design Methods using admixtures.	**04**
4.	Stress- Strain relationship for concrete, correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.	**06**
5.	Non-Destructive testing of concrete	**04**
6.	Software applications for design of Reinforced Concrete Structures	**06**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Design concrete mixes using different methods of proportioning and develop understanding of the effects of various parameters on concrete.
2.	Design RCC columns subjected to various type of loading.
3.	Design RCC slabs using different approaches.
4.	Design liquid retaining structures.

Bibliography:

S. No	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Raju Krishna, "Advanced R.C. Design", CBS Publishers, Hyderabad	2016
2.	Jain A.K., "Limit State Design", Nem Chand & Bros, Roorkee	2012
3.	Shetty M.S., "Concrete Technology", S. Chand & Company, New Delhi	2015
4.	Gambhir M.L, "Concrete Manual", Dhanpat Rai & Co. New Delhi	2014
5.	Kaushik & Kukreja, "Material Testing Laboratory Manual", Standard Publications, New Delhi	2010
6.	Neville, "Properties of Concrete", Pearson Education Limited London	2012
7.	Relevant IS codes (Latest Revision)	

Classical Books:

S. No	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Park and Pauley, "Reinforced Concrete Structures", Wiley-Interscience Publications, New Jersey	1975
2.	Jain & Jai Krishana, "Plain and Reinforced Concrete", Nem Chand & Bros, Roorkee	1984

MOOCs on this course are available at:

1. https://degrees.griffith.edu.au/course/7304ENG
   By Dr Jeung-Hwan Doh, Griffith University, Australia

2. https://onlinecourses.nptel.ac.in/noc17_ce23/preview
   By Nirjhar Dhang, Indian Institute of Technology, Kharagpur

	PO1	**PO2**	**PO3**	**PO4**
CO1	3	3	3	3
CO2	3	2	3	3
CO3	3	2	2	2
CO4	2	2	2	2
Target PO	2.75	2.25	2.50	2.50

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	**:**	**Advanced Concrete Technology PEC-I**
Course Code	**:**	**STR1201**
Credits	**:**	**3**
L-T-P	**:**	**3-0-0**

Total no. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1	To familiarize the students with latest trends in concrete technology and properties of concrete.
2	To impart knowledge for conduct of NDT for concrete structures.
3	To impart knowledge for conducting micro structure analysis of concrete.

Course Contents:

S. No.	Course Contents	No. of Lectures
1	**Special Concretes:** Fly ash concrete, Reaction mechanism of Fly ash, Mix Design procedure for Fly ash Concrete. Use of recycled aggregates in conventional and flyash concrete, fibre reinforced concrete and their applications.	**6**
2	**High Performance Concrete:** Materials for High Performance Concrete, Properties of HPC, Self-compacting concrete and its properties, RMC, Guidelines for mix proportioning of HPC and self-compacting concrete.	**8**
3	**Polymer Concrete:** Classification of Polymer concrete, Properties of constituent materials, Polymer impregnated concrete, polymer modified concrete, Properties and applications of Polymer and Polymer Impregnated concrete.	**8**
4	**Alkali Activated Concrete:** Classification of Alkali-activated concrete, Properties of constituent materials, Mix Design procedures, Curing Conditions, Mechanical and Durability properties.	**8**
5	**Microstructure analysis of concrete:** Introduction to various test methods of microstructure analysis of concrete such as SEM, XRD, XRF, DTA/TGA, particle size analysis and other material characterization techniques.	**6**
6	**Nondestructive testing of concrete:** Rebound hammer test, UPV test, Re-bar scanning, concrete core test, rebar corrosion test, IS codal specifications, introduction to chemical analysis tests of concrete.	**6**

Course Outcomes:

The outcomes of the course are that the student shall be able to:	
1	Apply the technology used in design of special concretes.
2	Perform and interpret NDT tests and microstructure test for concrete.
3	Make high-performance concrete.
4	Make use of the waste materials for making concrete.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of publication/ reprint

1	Neville, Adam M., and Jeffrey John Brooks. "Concrete technology". England: Longman Scientific & Technical.	1987
2	John Newman and BS Choo, "Advanced Concrete Technology" Elsevier.	2003
3	Gambhir, Murari Lal., "Concrete technology: theory and practice". Tata McGraw-Hill Education.	2013
4	Michael Thomas "Supplementary Cementitious materials in concrete" CRC Press, Taylor and Francis.	2013
5	Mehta, PK, Paulo, Monteiro, JM, "Concrete microstructure, properties & Materials", Prentice Hall INC & Mcgraw Hill USA.	2005
6	Relevant IS codes (Latest Revision)	

MOOCs on this course are available at:

1. https://onlinecourses.nptel.ac.in/noc19_ce44/preview
   By Prof. Manu Santhanam, Indian Institute of Technology, Madras

2. https://www.classcentral.com/course/swayam-advanced-concrete-technology-13886
   By Prof. Kousik Deb, Indian Institute of Technology, Kharagpur

	PO1	**PO2**	**PO3**	**PO4**
CO1	3	2	2	3
CO2	3	2	2	3
CO3	3	2	2	3
CO4	3	2	2	3
Target PO	3	2	2	3

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	**:**	**Advanced Foundation Engineering PEC-I**
Course Code	**:**	**STR1202**
Credits	**:**	**3**
L T P	**:**	**3-0-0**

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To learn the different types of foundation and their suitability for particular site and structure.
2.	To understand soil-structure interaction and calculation of allowable load and settlement of the foundation.
3.	To understand the phenomena of soil liquefaction, the associated remedial measures and to assess the requirements of foundations in difficult soils.
4.	To familiarize with the concept of sheet piles.

Course Contents:

S. No.	Course Contents:	No. of Lectures
1.	**Shallow Foundations:** Design considerations- factors of safety (Including limit state), allowable settlements, location and depth of foundations, Codal provisions, Consolidation settlement in clays (with correction factors). Immediate settlement. Settlement in sands from N-Values, elastic solutions. Static cone tests, Plate load tests.	**8**
2.	**Deep foundations:** Type of Piles. Construction methods. Axial capacity of single piles-static formulae, Skin friction and end bearing in sands and clays. Axial capacity of group of piles, Codal provisions. Laterally Loaded Piles: Short and long piles, Free head and fixed head piles, Lateral load capacity of single piles, Lateral deflection, Elastic analysis, Group effect, Lateral load test, Codal provisions. Caissons and Wells, Stability of Well foundations by IRC Method, Construction, Tilts and Shifts.	**10**
3.	**Soil Structure Interaction:** Introduction to soil-foundation interaction problems, soil behavior, Foundation behavior, Interface behavior, Soil Foundation interaction analysis, Soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior.	**8**
4	**Soil Liquefaction and remedial measures**: soil liquefaction, stone column, vibrofloatation, deep compaction and foundations in difficult soils such as expansive soils, chemically aggressive soils, soft soils and fills.	**8**
5.	**Sheet Pile Structures:** Types, Cantilever, Anchored sheet, Design by free earth & fixed earth method, Anchored braced sheeting, Cofferdams, Stability of cellular cofferdam, Instability due to heave of bottom.	**8**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Decide the type of foundation required for a particular site and structure.
2.	Design of the foundations for civil engineering structures under varied field conditions.

3.	Apply the concepts of soil-structure interaction, liquefaction of soils.
4.	Identify and design various sheet pile structures and perform analysis of machine foundations.

Bibliography:

S.No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1.	Joseph E. Bowles, "Foundation Analysis and Design", Mc-Graw Hill Publications	1997
2.	Kaniraj S.K., "Design aids in soil mechanics and foundation engineering", Mc-Graw Hill Publications	1988
3.	Relevant IS codes (Latest Revision)	

Classical Books:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Poulos H.G. and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley	1980

MOOCs on this course are available at:

1. https://nptel.ac.in/courses/105105039/
   By Prof. Kousik Deb, Indian Institute of Technology, Kharagpur

2. https://freevideolectures.com/course/2674/foundation-engineering
   By Prof. N.K. Samadhiya, Indian Institute of Technology, Roorkee

3. https://www.surrey.ac.uk/postgraduate/advanced-geotechnical-engineering-msc-2018
   By Prof. S. Bhattacharya, University of Surrey, England

	PO1	PO2	PO3	PO4
CO1	2	1	3	2
CO2	2	1	3	2
CO3	2	1	3	2
CO4	2	1	3	2
Target PO	2	1	3	2

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	**:**	**Seismic Resistant Design of Structures PEC-I**
Course Code	**:**	**STR1203**
Credits	**:**	**3**
L T P	**:**	**3-0-0**

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To impart knowledge regarding basics of earthquakes and its terminology.
2.	To expose students to the basic concepts of seismic analysis of structures as per IS codal provisions.
3.	To impart knowledge of seismic resistant design for structural components of RCC and steel structural members.
4.	To provide knowledge for seismic resistant design of masonry structures.

Course Contents:

S. No.	Contents	No of Lectures
1.	**Earthquakes:** Earthquake phenomenon cause of earthquakes, Faults, Plate tectonics, Seismic waves, Terms associated with earthquakes, Magnitude/Intensity of an earthquake-scales, Energy released, Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph.	**3**
2.	**Basic Concepts:** Seismic performance of structures and structural components during earthquakes, ground motion parameters, response spectrum, design spectrum.	**5**
3.	**Seismic Analysis of Buildings:** Equivalent static analysis, response spectrum analysis, mode superposition method, Time history analysis, Modelling concept of reinforced concrete building.	**9**
4.	**Push Over Analysis:** Concept, Strong column weak beam mechanism, moment magnification factors, Capacity Design for beams & columns.	**5**
5.	**Seismic Resistant Design of R C C Building Components:** Seismic resistant properties of reinforced concrete components, Seismic Behavior and design of reinforced concrete elements, Analysis and Design of Shear walls, Concept of Soft Storey, IS codal provisions.	**9**
6.	**Seismic Provisions for Steel Buildings:** Materials, connections, joints and Fasteners, Columns, Ordinary, intermediate and special moment resisting frames.	**7**
7.	**Earthquake Resistant Design of Brick Masonry Structures:** Introduction, Behavior of masonry walls, Box action and bands, Improving seismic behavior of masonry buildings.	**4**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Understand earthquake phenomenon and terms associated with earthquakes.
2.	Perform seismic resistant design of RCC structural components.
3.	Perform seismic resistant design of steel structural components.
4.	Perform seismic resistant design of masonry walls.

Bibliography:

S. No.	Name of Books/ Authors/ Publishers	Year of publication /reprint
1.	T. and Priestley, M.J.N "Seismic Design of Reinforced Concrete and Masonry Buildings", John-Wiley & Sons, Inc., Pauley.	1992
2.	Edmund Booth, "Concrete Structure in earthquake regions – Design & Analysis" Longman Scientific & Technical.	1994
3.	Penelis, George G., and Kappos, Andreas J., E & FN Spon "Earthquake Resistant Concrete Structures"	1997
4.	"Building Seismic Safety Council", Federal Emergency Management Agency, Washington, D.C, FEMA 356, 2000, FEMA 440 / ATC 55, 2005, FEMA 310	1998
5.	Edmund Booth and David Key, Tomas Telford, "Earthquake Design Practice for Buildings"	2006
6.	Duggal. S.K, "Earthquake-Resistant design of Structures", Oxford University Press.	2015
7.	Relevant IS codes (Latest Revision)	

MOOCs on this course are available at:

1. nptel.ac.in/courses/105/102/105102016/
   By Dr. Ashok Gupta, Indian Institute of Technology, Delhi

2. https://nptel.ac.in/courses/105101004
   By Dr. R.S. Jangid, Indian Institute of Technology, Bombay

	PO1	PO2	PO3	PO4
CO1	2	2	2	2
CO2	3	2	3	2
CO3	3	2	3	2
CO4	3	2	3	2
Target PO	2.75	2	2.75	2

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	**:**	**Liquid Retaining Structures PEC-I**
Course Code	**:**	**STR1204**
Credits	**:**	**3**
L-T-P	**:**	**3-0-0**

Total no. of lectures: 42

Course Objectives:

The main objectives of the course are:	
1	To impart knowledge regarding the analysis and design of RCC liquid retaining structures.
2	To impart knowledge regarding the analysis and design of steel tanks for storage of liquids.

Course Contents:

S. No.	Course Contents	No. of Lectures
1	**Introduction to liquid retaining structures:** Types of tanks, Materials, Types of joints, IS codal provisions, hydrodynamic analysis.	**5**
2	**RCC Tanks resting on ground:** Design considerations, limit state design of circular and rectangular tanks resting on ground.	**7**
3	**RCC Under Grounds Tanks:** Circular and rectangular tanks, Problem of high ground water table, limit state design of underground RCC tanks.	**10**
4	**Elevated RCC Tanks:** Elevated tanks of different shapes with staging arrangement of columns/cylindrical shaft. Design of tank foundations. A complete design and drawings of Intze type O.H.S.R.	**10**
5	**Elevated Steel Tanks:** Circular tanks with conical bottom, Circular tank with segmental bottom, Design considerations, Staging, Pressed steel plate tanks.	**10**

Course Outcomes:

The outcomes of the course are that the students shall be able to:	
1	Design underground structures for storage of liquids.
2	Design of RCC elevated structures for storage of liquids.
3	Design of elevated steel tanks for storage of liquids.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of publication/ reprint
1	Punmia B.C., “RCC designs”, Laxmi Publication pvt. Ltd.	2010
2	Syal I.C., “Reinforced Concrete Structures”.	2007
3	Chandra Ram, “Reinforced concrete structure (limit state design)”,	2018

	Standard book house, Delhi.	
4	Arya and Ajmani, "Design of Steel Structures".	2001
5	Relevant IS codes (Latest Revision)	

MOOCs on this course are available at:

1. https://www.istructe.org/resources/library/design-of-liquid-retaining-concrete-structures/
   By John, Martin, Andrew J., United Kingdom

	PO1	**PO2**	**PO3**	**PO4**
CO1	3	3	2	3
CO2	3	3	2	3
CO3	3	3	2	3
Target PO	3	3	2	3

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

SEMESTER II

Course Name	:	**Pre-stressed Concrete Structures PCC-IV**
Course Code	:	**STR1104**
Credits	:	**3**
L T P	:	**3-0-0**

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To familiarize the students with concept and behaviour of pre-stressed concrete.
2.	To impart knowledge to design pre-stressed concrete flexural members.
3.	To impart knowledge to design pre-stressed concrete members subjected to axial load.
4.	To impart knowledge to design pre-stressed concrete composite sections.

Course Contents:

S. No.	Course Contents	No. of Lectures
1.	**Introduction to Prestressing:** Principles of pre-stressing, materials of pre-stressing, pre-stressing systems, losses of prestress.	**4**
2.	**Analysis of Prestress:** Analysis of prestress, Thrust Lines, Cable profile and cable layout, concept of load balancing and stresses in cables.	**6**
3.	**Prestressed Concrete Beams:** Flexural Design of Prestressed concrete beams, Shear, Torsion and Bond, Deflection, IS codal specifications.	**8**
4.	**Anchorage Zone Stresses:** End blocks, Stress distribution in end blocks, Anchorage zone reinforcement.	**4**
5.	**Statically Indeterminate Prestressed Concrete Beams** Indeterminate pre stressed concrete beams- Advantages, Guyon's Theorem, design of continuous Prestressed concrete beams.	**8**
6.	**Pre-Stressed concrete members**: Design of prestressed concrete sections for axial compression and tension, one-way, Two-way slabs & Prestressed concrete floor systems.	**6**
7.	**Composite Prestressed Concrete Sections**: Types, Analysis and design of composite sections.	**6**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Analyse the stresses in pre-stressed concrete.
2.	Design pre-stressed concrete flexural members.
3.	Design pre-stressed concrete structures.
4.	Design pre-stressed concrete composite sections.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Lin T.Y., "Design of Prestressed Concrete structures", Wiley Interscience, Publication, New Jersey	2006
2.	Natarajan V., "Fundamentals of Prestressed Concrete", B.I. Publications, New Delhi	1983
3.	Raju Krishna N., "Prestressed Concrete", McGraw Hill Education	2019
4.	Dayaratnam P., "Prestressed Concrete Structures 7Th Edition", Medtech publisher	2017
5.	Annie J.P., "Prestressed concrete analysis and design", S.K. Kataria publishers	2018
6	Relevant IS codes (Latest Revision)	

Classical Books:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Magnel G., "Prestressed Concrete", Concrete Publications Limited, London	1954

MOOCs on this course are available at:

1) http://nptel.ac.in/courses/105106118/
Course: Prestressed Concrete Structures
Professor: Amlan K. Sengupta, PhD PE at IIT Madras

2) https://freevideolectures.com/course/94/prestressed-concrete-structures

	PO1	PO2	PO3	PO4
CO1	3	2	2	2
CO2	2	1	3	2
CO3	2	3	2	1
CO4	3	2	2	1
Target PO	2.5	2	2.25	1.5

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	:	**Advanced Steel Structures**	**PCC-V**
Course Code	:	**STR1105**	
Credits	:	**3**	
L T P	:	**2-0-2**	

Total No. of Lectures: 28

Total No. of Lab Hours: 28

Course Objectives:

The main objectives of the course are:	
1.	To impart knowledge to perform plastic design for beams and portal frames.
2.	To impart knowledge to perform design of industrial steel building components.
3.	To impart knowledge to perform design of a plate girder.
4.	To impart knowledge to use softwares for analysis and design of buildings.

Course Contents:

S. No.	Course Contents	No. of Lectures
1.	**Plastic Analysis and design of Beams:** Introduction to theory of plastic bending, Single span and continuous Beams, Moment Balancing Method, plastic analysis and design of portal frames.	**8**
2.	**Design of Steel Trussed Roofs:** Types of trusses, pitch of trusses, design loads, analysis and limit state design of truss members, design of purlins, bracings, end bearing design.	**5**
3.	**Design of gantry girder:** Loads, profile of gantry girder, limit state design of gantry girder.	**5**
4.	**Industrial steel building:** Introduction, planning, structural framing, elements of an industrial building, analysis of trussed bent, design steps of industrial building.	**5**
5.	**Design of plate girder:** Elements of plate girder, economical depth, design of plate girder components, design of connections, design of stiffeners, design of splices.	**5**

Lab Work:

S. No.	**Lab contents** Using software:	No. of Hours
1.	Modelling of geometry and section properties for a framed building.	**04**
2.	Applying loads and its combinations.	**04**
3.	Dynamic analysis of the framed structure for its output parameters.	**04**
4.	Design of structural components.	**04**
5.	Modelling of geometry and section properties for an industrial building.	**04**
6.	Analysis and design of an industrial building.	**04**
7.	Introduction to non-linear analysis.	**04**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Analyse beams and portal frames using plastic theory.
2.	Design industrial steel building and its components.
3.	Design steel plate girder.
4.	Use softwares for the analysis and design of buildings.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Neal, "Plastic Design".	1977
2.	Salmon and Johnson, "Steel Structure- Design and Behaviour", Harper and Row publisher.	1980
3	Merritt, "Structural Steel Designer's Hand Book ".	2011
4	Handbook for Structural Engineers, SP: 6(6)-1972.	1972
5	Relevant IS codes (Latest Revision)	

Classical Books:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1	Baker J.F., "The steel skeleton Volume I and II", Publication English Language Book Society.	1954
2	Hedge G., "Plastic analysis of steel structures", Philips.	1959
3	LYNN.S., "Plastic Design of Steel Frames", Beedle.	1966

MOOCs on this course are available at:

1. http://www.nptelvideos.in/2012/11/design-of-steel-structures.html
   By Dr. Damodar Maity, Indian Institute of Technology, Guwahati

2. https://ep.jhu.edu/programs-and-courses/565.620-advanced-steel-design
   By Dr. Wheaton of Whiting School of Engineering, US

	PO1	PO2	PO3	PO4
CO1	3	3	2	3
CO2	3	2	2	2
CO3	3	2	3	3
CO4	3	2	1	2
Target PO	3	2.25	2	2.25

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	:	**Bridge Engineering PCC-VI**
Course Code	:	**STR1106**
Credits	:	**3**
L T P	:	**3-0-0**

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To study different types of structural configurations for bridges and codal provisions for loading and design of highway and railway bridges.
2.	To familiarize with the types, suitability, selection, design criteria of various types of RCC bridges.
3.	To impart knowledge for analysis and design of various types of steel bridges.
4.	To select and analyse different types of bearings for bridges.

Course Contents:

S. No.	Course Contents:	No. of Lectures
1.	**General Bridge Systems:** Considerations in alignment, Planning, Economic considerations, Aesthetics and selection of type of bridge, Geometrical Proportions, Bridge Hydrology, Scour Depth, Depth of foundation, Estimation of Design Discharge, load test on bridges.	**3**
2.	**Loading Standards*:*** Specifications for loading, Rail and Road bridges, Indian Road Congress and Indian Railway loading standards.	**4**
3.	**Design of RCC Bridges:** Reinforced Concrete Bridges: Slab culverts, T-Beam Bridges, Introduction to Box Girder Bridges.	**10**
4.	**Design of Steel bridges:** Design of Deck Type Plate Girder Bridge, Design concepts of steel trussed bridge.	**12**
5.	**Bridge Bearings:** Types, Design of Bearings.	**4**
6.	**Design of sub structure:** Seismic resistant design of Piers and Abutments of bridges.	**4**
7.	**Bridge foundations:** Types and general design criteria, Design concepts of open, pile and well foundation for piers and abutments.	**5**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Plan and design the superstructure of RCC bridges.
2.	Plan and design the superstructure of Steel bridges.
3.	Plan and design the substructure of a bridge and its foundation.
4.	Plan and design the bearing of the bridge.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Raju Krishna N.," Design of Bridges", Oxford, IBH Publications	2006
2.	Victor D.J, "Essential of Bridge Engineering", Oxford, I.B.H.	2014
3.	Rajagopalan N.," Bridge Superstructure", Naroda Publishing House	2006
4.	Bridge Engineering Handbook, W. F. Chen and L. Duan, CRC press	2003
5.	O'Brien E. J., and Keogh Bridge D. L, " Deck Analysis", Taylor and Francis	1999
6.	Eggert H. and Kauschke W., "Structural Bearings", Ernst & Sohn	2002
7	Relevant IS codes (Latest Revision)	

Classical Books:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Bakht B. and Jaeger L.G., "Bridge Analysis Simplified", McGraw Hill	1987
2.	Fryba L., "Dynamics of Railway Bridges", Thomas Telford	1996

MOOCs on this course are available at:

1. http://enggprog.com/archives/2011/12/25/lectures-on-introduction-to-bridge-engineering
   By Dr. Shahzad Rahmad, University of Engineering and Technology, Peshawar

2. https://onlinecourses.nptel.ac.in/noc17_ce24/preview
   By Prof. Nirjhar Dhang, Indian Institute of Technology, Kharagpur

	PO1	PO2	PO3	PO4
CO1	3	3	3	2
CO2	3	3	3	2
CO3	3	3	3	2
CO4	3	3	3	2
Target PO	3	3	3	2

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	:	**Plated and Shell Structures PEC-II**
Course Code	:	**STR1251**
Credits	:	**3**
L T P	:	**3-0-0**

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To impart knowledge for understanding the structural behaviour of plates.
2.	To develop the competence to design plated structures.
3.	To impart knowledge for understanding the structural behaviour of shells.
4.	To develop the competence to analyse folded plates.

Course Contents:

S. No.	Course Contents:	No. of Lectures
1.	**Pure Bending of Plates:** Slope and curvature, Relation between bending moments and curvature, Strain Energy.	**6**
2.	**Rectangular Plates:** Differential equation of the deflection surface (small deflection theory only). Fourier series expansion for various type of loads, rectangular plate with various loadings and edge conditions, Navier's and Levy's methods.	**6**
3.	**Symmetrical Bending of Circular Plates:** Differential equation in polar coordinates, uniformly loaded circular plate with or without a hole at the centre and with various edge conditions, stress couple, Annular Plates.	**6**
4.	**Buckling of Thin Plates:** Derivation of Governing equations, Column buckling, Plate buckling.	**6**
5.	**Shell Structures:** Elements of Differential Geometry, Classifications of Shells, Shells of revolution loaded symmetrically with respect to their axis, Membrane theory, Application to conical shells, Spherical shells, Shells of revolution under unsymmetrical loading.	**8**
6.	**Cylindrical Shells:** Membrane theory, General theory for circular cylindrical shell loaded symmetrically with respect to its axis, Circular cylindrical tank with various edge conditions.	**6**
7.	**Folded Plates:** Introduction to Folded Plates, Beam action, Plate action, Stress distribution, Introduction to Simpson method.	**4**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Analyse rectangular plated structures.
2.	Analyse various types of circular plated structures.
3.	Analyse shell structures.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Szilard R., "Theory and analysis of Plates", Prentice Hall, New Jersey	1973
2.	Donnel, L.H., "Beams Plates and Shells", McGraw Hill, New York	1976
3.	Chatterjee, "Design of Shell Roofs", Chapman & Hall, London	1988
4.	Wang, C.M., "Analysis and design of plated structures", Woodwad, New York	2007
5.	Ansel C. Ugural, "Plates and Shells: Theory and Analysis", Fourth Edition, CRC Press	2017
6.	Bhavikatti S.S., "Theory of Plates and Shells", New Age International Publisher	2019
7.	Reddy J.N., "Theory and Analysis of Elastic Plates and Shells", Boca Raton Publisher	2006
8.	Relevant IS codes (Latest Revision)	

Classical Books:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Timoshenko, "Theory of Plates & Shells", McGraw Hill, New York	2004
2.	Paduart, A, "Shell Roof Analysis", Cement & Concrete Association	1966
3.	Jack R Vinson, "Structural Mechanics: the behaviour of Plates and Shells", John Wiley and Sons.	1974

MOOCs on this course are available at:

1) https://freevideolectures.com/course/2679/design-of-steel-structures
   By Prof. Damodar Maity, Indian Institute of Technology Guwahati

	PO1	PO2	PO3	PO4
CO1	3	1	3	2
CO2	3	1	3	2
CO3	3	1	3	2
Target PO	3	1	3	2

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	:	**Finite Element Method in Civil Engineering PEC-II**
Course Code	:	**STR1252**
Credits	:	**3**
L T P	:	**3-0-0**

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To impart knowledge about basic concepts of FEM.
2.	To impart knowledge to analyse various structural elements using FEM.
3.	To impart knowledge to perform stress analysis using FEM.
4.	To impart knowledge of performing numerical integration, use of isoparametric elements.

Course Contents:

S. No.	Course Contents:	No. of Lectures
1.	**Basic concepts of finite element method**: Basic concepts in a finite element solution, General finite element solution procedure, concept of shape functions, Application to axial deformation of bars, Axial spring element.	**6**
2.	**Approximate solution of boundary value problems:** Methods of weighted residuals, Approximate solution using variational method, Modified Galerkin method, Boundary conditions and general comments, Two-dimensional example.	**6**
3.	**Numerical integration:** Newton-Cotes rules, Trapezium rule, Simpson's rule, Error term, Gauss-Legendre rules, Changing limits of integration, Gauss-Laguerre rule, Multiple integrals, Numerical integration for quadrilateral elements, Numerical integration for triangular elements.	**6**
4.	**Analysis of trusses:** Two-dimensional truss element, Three-dimensional space truss element, Stresses due to lack of fit and temperature changes.	**6**
5.	**Beam bending:** Governing differential equation for beam bending, two node beam element, Exact solution for uniform beams subjected to distributed loads using superposition, Calculation of stresses in beams, Thermal stresses in beams.	**6**
6.	**Analysis of structural frames:** Plane frame element subjected to inplane loading, Thermal stresses in frames, Three-dimensional space frame element.	**6**
7.	**Higher order elements for one dimensional problem:** Shape functions for second order problems, Isoparametric mapping concept, Quadratic isoparametric element for general one-dimensional boundary value problem, One dimensional numerical integration.	**6**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Use FEM as a tool to find approximate solution of differential equations.

2.	Analyse structural frameworks using FEM stress analysis.
3.	Use isoparametric elements in FEM.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Logan D. L., "A First Course in the Finite Element Method", Thomson-Engineering, 3rd edition.	2001
2.	Reddy, J. N, "An Introduction to the Finite Element Method", McGraw-Hill Science/Engineering/Math	2005
3.	Bhatti, M.A., "Fundamental Finite Element Analysis and Applications: with Mathematica and MATLAB Computations", Wiley.	2005
4.	Desai C.S., "Introduction to Finite Element Method", CBS Publisher	1998
5.	Jain A.K., "Advance Structural Analysis", Nem Chand & Bros	2015
6.	Chandrupatla T. R., "Introduction to Finite Elements in Engineering", Prentice Hall.	2003
7.	Relevant IS codes (Latest Revision)	

Classical Books:

S.No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1	Zeiekiwitz and Cheung, "Finite Element Methods", Tata McGraw Hill Publishing, Pvt. Ltd.	1967
2	Pei Chi Chou, "Elasticity, Tensor, Dyadic and Engg Approache", University Series in Basic Engineering	1967

MOOCs on this course are available at:

1) https://nptel.ac.in/courses/105106051
   By Prof. B.N. Rao, Indian Institute of Technology, Madras

	PO1	PO2	PO3	PO4
CO1	3	2	3	2
CO2	3	2	3	2
CO3	3	2	3	2
Target PO	3	2	3	2

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	**:**	**Health Monitoring and Retrofitting of Structures PEC-II/O.E-I**
Course Code	**:**	**STR1253/STR3001**
Credits	**:**	**3**
L-T-P	**:**	**3-0-0**

Total no. of lectures: 42

Course Objectives:

The main objectives of the course are:	
1	To attain knowledge of structural health monitoring of buildings.
2	To attain knowledge of causes of distress and rehabilitation of existing concrete buildings.
3	To learn strengthening techniques of structural elements.

Course Contents:

S. No.	Course Contents	No. of Lectures
1	**Structural Health and Audit:** Structural Health Monitoring: Concepts, Various Measures, Assessment of Health of Structure, Investigation Management.	**8**
2	**Field Testing:** Types of static and dynamic Tests, Remote Structural Health Monitoring, introduction to smart materials and sensors.	**8**
3	**Deterioration and Evaluation of Concrete Buildings:** Deterioration**:** Embedded Metal Corrosion, Disintegration Mechanisms, Moisture Effects, Thermal Effects, Structural Effects, Faulty Construction. Evaluation: Visual Investigation, Destructive Testing Systems, Non-Destructive Testing Techniques, Semi-Destructive Testing Techniques.	**10**
4	**Surface Repair & Retrofitting Techniques**: Strategy & Design, Selection of Repair Materials, Surface Preparation, Bonding repair Materials to Existing concrete, Placement Methods, Shotcrete/Gunite, Grouting.	**8**
5	**Strengthening Techniques:** Strengthening Techniques, Beam Shear Capacity strengthening, Column Strengthening, Flexural Strengthening.	**8**

Course Outcomes:

The outcomes of the course are that the students shall be able to:	
1	Perform repair, strengthening, retrofitting and rehabilitation of structures.
2	Apply the concept of distress mapping for the retrofitting of structures.
3	Apply the strategies of surface repair and retrofitting techniques.
4	Assess the health of structures using field test methods.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of publication/ reprint
1	ATC- 40: “Seismic Evaluation and Retrofit of Concrete Buildings”, Vol. 1 & 2.	1997

2	Bohni, H, "Corrosion in Concrete Structures", CRC Press.	2005
3	Bungey, S, Lillard, G and Grantham, MG, "Testing of Concrete in Structures", Taylor and Francis.	2006
4	FEMA 273, NEHRP "Guidelines for the Seismic Rehabilitation of Buildings".	1999
5	Emmons, PH, "Concrete Repair and Maintenance", Galgotia Publication.	2012
6	Malhotra, VM and Carino, NJ, "Handbook on Non-destructive Testing of Concrete", CRC Press.	2004
7	Douglas E Adams, "Health Monitoring of Structural Materials and Components Methods with Applications", John Wiley and Sons.	2007
8	J. P. Ou, H. Li, "Structural Health Monitoring and Intelligent Infrastructure", Taylor and Francis Group, London, UK.	2006
9	Relevant IS codes (Latest Revision)	

MOOCs on this course are available at:

1. https://onlinecourses.nptel.ac.in/noc22_ce20/preview
   By Prof. Swati Maitra, Prof. Sriman Kumar Bhattacharyya, Indian Institute of Technology, Kharagpur

	PO1	**PO2**	**PO3**	**PO4**
CO1	3	2	3	3
CO2	3	2	2	3
CO3	3	3	3	2
CO4	3	3	3	3
Target PO	3	2.5	2.75	2.75

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	:	**High Rise Buildings** **PEC-II**
Course Code	:	**STR1254**
Credits	:	3
L T P	:	3-0-0

Total No. of Lectures: 42

Course Objectives:

The main objectives of the course are:	
1.	To familiarize the students with the concepts and forms of structural system for high rise buildings.
2.	To familiarize the students with the concepts of loading on high rise buildings and analysis of high rise building with approximate methods for lateral loads.
3.	To familiarize the students with the concepts of creep, shrinkage and temperature effects on high rise buildings and second order effects of gravity loading.
4.	To familiarize the students with the concepts of shear wall design in high rise buildings

Course Contents:

S. No.	Course Contents	No. of Lectures
1	**Structural systems and concepts:** Behavior of high-rise structures, rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Steel-Concrete Composite.	**6**
2	**Loading on high rise structures:** Gravity, Live, wind and earthquake loading. Wind load calculation as per IS 875 (Part-3). Earthquake load calculation as per IS 1893, temperature loads.	**8**
3	**Approximate methods for analysis of tall buildings**: Approximate methods of analysis, Interaction of frames, shear-wall frames, Torsion in frames.	**8**
4	**Analysis and design of shear wall:** Analysis, design of shear walls, Introduction to coupled shear wall.	**6**
5	**Secondary effects:** Creep, shrinkage and temperature effects on tall buildings.	**6**
6	**Overall buckling analysis of frames**: Buckling analysis of frames, wall-frames, and second order effects of gravity loading, P- delta analysis in steel and concrete buildings.	**8**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Select suitable structural system for tall buildings.
2.	Analyse tall buildings under gravity, wind and earthquake loading.
3.	Perform design of shear wall in a tall building.
4.	To analyse the effect of creep, shrinkage and temperature effects on tall buildings.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Taranath Bungale, "Structural Analysis and Design of Tall Buildings" McGraw Hall 1987.	1987
2.	Beedle L.S. "Advances in Tall Buildings" VMR.	1986
3.	Kazimi. S.M.A. "Analysis of Shear walled Buildings".	1976
4.	Schueller, "High Rise Building Structures".	1986
5.	Tall Building Structures: Analysis and Design- B. Stafford Smith & A. Coull.	1991
6.	Relevant IS codes (Latest Revision)	

MOOCs on this course are available at:

1. https://onlinecourses.nptel.ac.in/noc22_ar01/preview
   By Prof. Shubhajit Sadhukhan, Indian Institute of Technology, Roorkee

	PO1	PO2	PO3	PO4
CO1	3	2	3	3
CO2	3	2	3	3
CO3	3	3	3	3
CO4	3	2	3	3
Target PO	3	2.25	3	3

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	:	**Building Services** **PEC-II/O.E.-I**
Course Code	:	**STR1255/STR3002**
Credits	:	**3**
L T P	:	**3-0-0**

Total No. of Lectures: 42

Course Objectives

The main objectives of the course are:	
1.	To familiarize the students with planning, design and utility services of residential and commercial buildings.
2.	To impart knowledge of various construction management techniques.

Course Contents:

S. No.	Course Contents	No. of Lectures
1.	**Architectural planning and design of buildings:** Introduction, smart and green buildings, case studies of specialized buildings, planning, landscaping etc. for the architectural design /development of residential and commercial complexes.	**12**
2.	**Utility Services in Residential and Commercial buildings:** Sanitation, Water supply, Electrical wiring, Rain water disposal, Lighting and illumination, firefighting, solar energy panels, sensor- b a s e d security systems, sound insulation in buildings.	**12**
3.	**Air Conditioning & Ventilation:** Natural ventilation, Control cooling systems, Modern systems of air conditioning, Ducting systems, Different mechanical means of air conditioning, central air conditioning system. Working out air conditioning loads for different spaces.	**8**
4.	**Thermal Insulation:** Behaviour of various building materials & thermal conductivity, Thermal insulation for air-conditioned interior spaces.	**5**
5.	**Construction technology:** Introduction to latest trends in construction of buildings, design of formwork for buildings, Safety Audit of buildings.	**5**

Course Outcomes:

At the completion of the course, students will be able to:	
1.	Design residential and commercial buildings along with the utility services.
2.	Apply construction management techniques in the field of construction technology.

Bibliography:

S. No.	Name of Book/Authors/Publisher	Year of Publication/ Reprint
1.	Salvadori & Levy, "Structural Design in Architecture", Prentice Hall, New Jersey	1981
2.	Simonds J.O., " Landscape Architecture", McGraw Hill Education, New York	2013
3.	Relevant IS codes (Latest Revision)	

MOOCs on this course are available at:

1. https://www.coursera.org/specializations/construction-management
   By Ibrahim Odeh, Ph.D., Columbia University

	PO1	PO2	PO3	PO4
CO1	3	3	3	3
CO2	3	3	3	3
Target PO	3	3	3	3

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.

Course Name	:	**Design of Experiments and Research Methodology**
Course Code	:	**STR1001**
Credits	:	**3**
L T P	:	**3 0 0**

Course Objectives

The main Objectives of this course are:	
1	To introduce the fundamentals of Statistical techniques, Sampling techniques, and Data Collection and the interpretation to the students.
2	To make the students understand the concept of research, need for research, types of research and steps in conducting research.

Total Nos. of Lectures: 42

Course Contents:

S. No.	Course Contents	No. of Lectures
1	**Introduction:** Principles of design of experiment, Methodology for design of experiment, Screening design, Factorial design, Randomized design.	**3**
2	**Sample & Estimation:** Population, Sample, Probability in sampling, sampling with replacement, parameters of samples.	**3**
3	**Probability and random variables:** Bayesian probability, conditional probability, Bayes theorem, statistical independence of events, random variables- discrete and continuous, probability distribution functions, cumulative distribution functions, Expectation and variance of a random variable, joint distribution of two random variables and their correlation.	**6**
4	**Statistics for Engineers:** Discrete & Continuous distributions, different distributions functions application in engineering, distribution estimation & its assessment.	**6**
5	**Simulation:** Monte Carlo method, Queuing theory, Markovian process.	**3**
6	**Random Variables Data Analysis:** Single and multi- variables data analysis, estimation of parameters, spline smoothing, residual analysis, ANOVA.	**6**
7	**Modelling:** Introduction to modelling, types of models, development of mathematical models	**3**
8	**Geostatistics:** Introduction to Geostatistics, Geostatistical data analysis methods.	**4**
9	**Stochastic Processes:** Time series analysis, model identification, forecast and uncertainty analysis.	**4**
10	**Research Report Writing:** Purpose and nature of research, Research ethics Research proposal and literature review, Defining the problem, Finding and managing information, Developing and stating hypotheses. Research report, writing a thesis, writing for publication.	**4**

Course Outcomes:

At the completion of this course, students will be able to:	
1	Make use of various Research methodologies and its applications in the relevant field of engineering.
2	Organize and conduct research in a more appropriate manner.

Bibliography:

S. No.	Name of Book/Authors/Publishers	Year of Publication/ Reprint
1	Probability and Statistics for Engineers and scientists, Walpole, Myers, MyersandYe, Pearson Education.	7th edition, 2002
2	Statistics in Research, Bernand Ostleand Richard N. Mensing, Oxford & IBH Pub Co.	3rd edition,1975
3	Probability and Statistics in Engineering, Hines, Montgomery, Gold sman and Borror, John Wiley & Sons.	4th edition, 2003
4	Experimental design, Theory & application, Federer, Oxford & IBH pub Co.	1955
5	Introduction to probability & statistics for Engineers and scientists, Sheldon M. Ross Elsevier Academic press, California, USA	2014

MOOCs on this course are available at:

1. http://professional.mit.edu/programs/short-programs/design-and-analysis-experiments
   By Prof. Paul Berger, MIT Professional Education

2. https://nptel.ac.in/courses/107108011/
   By Prof. Amaresh Chakraborty, Indian Institute of Science, Bangalore

	PO1	PO2	PO3	PO4
CO1	3	3	3	3
CO2	3	3	3	3
Target PO	3	3	3	3

1 – Slight (Low) Correlation
2 – Moderate (Medium) Correlation
3 – Substantial (High) Correlation
"-" indicates there is no correlation.