# SYLLABUS

# OF

## *M. TECH*
## *(Structural Engineering)*
## *II YEAR*

## (CBCS)

### DEPARTMENT OF CIVIL ENGINEERING

## INTEGRAL UNIVERSITY
## LUCKNOW

# STUDY AND EVALUATION SCHEME (Full Time)

# M.Tech. (Structural Engineering)

# (w.e.f. 2021-22)

## Semester – III

| S. No. | Course Category | Code No | Name of Subject | Periods | | | | Evaluation Scheme | | | | Subject Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | Continuous Assessment (CA) | | | Exam ESE | |
| | | | | | | | | CT | TA | Total | | |
| 1 | DE | As per Annexure | Departmental Elective - II | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 2 | DE | As per Annexure | Departmental Elective - III | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 3 | DE | As per Annexure | Departmental Elective - IV | 3 | 1 | - | 4 | 40 | 20 | 60 | 40 | 100 |
| 4 | DC | CE616 | Directed Study | - | - | - | 4 | - | - | - | 100 | 100 |
| 5 | DC | CE699 | M.Tech Dissertation | - | - | - | 4 | - | - | 60 | 40 | 100 |
| **Total** | | | | **9** | **3** | **-** | **20** | | | | | **500** |

## Semester – IV

| S. No. | Course Category | Code No | Name of Subject | Periods | | | | Evaluation Scheme | | | | Subject Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | Continuous Assessment (CA) | | | Exam ESE | |
| | | | | | | | | CT | TA | Total | | |
| 1 | DC | CE699 | M.Tech Dissertation | - | - | - | 4 | - | - | 60 | 40 | 100 |
| 2 | DC | CE699 | M.Tech Dissertation | - | - | - | 4 | - | - | 60 | 40 | 100 |
| 3 | DC | CE699 | M.Tech Dissertation | - | - | - | 4 | - | - | 60 | 40 | 100 |
| 4 | DC | CE699 | M.Tech Dissertation | - | - | - | 4 | - | - | 60 | 40 | 100 |
| **Total** | | | | **-** | **-** | **-** | **16** | | | | | **400** |

**L –** Lecture; **T –** Tutorial; **P –** Practical; **C** – Credits; **CT** – Class Tests; **TA** – Teacher Assessment
**Continuous Assessment (CA)** = Class Tests + Teacher Assessment

**Subject Total** = Continuous Assessment (CA) + End Semester Examination (ESE)

**DC** – Departmental Core **DE** – Departmental Elective

**Departmental Elective – II**

CE601 Design of Bridges
CE602 Stability of Structures
CE604 Maintenance, Rehabilitation and Retrofitting of Structure

**Departmental Elective – III**

CE607 Industrial Structures
CE608 Prefabricated Structures
CE612 Computer Aided Design in Structural Engineering

**Departmental Elective – IV**

CE606 Design of Tall Buildings
CE611 A Seismic Design of Structures
CE613 Prestressed Concrete

**Integral University, Lucknow**

| **Effective from Session: 2015-16** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE601 | **Title of the Course** | Design of Bridges | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 1 | 0 | 4 |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To gain knowledge of basic of hydraulics as well as structural design consideration of short span bridge.<br>• To design of RCC and steel bridges.<br>• Impart knowledge of relevant bridge foundation and its design. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Lerner is made aware about selection criteria of type of bridge and various geometric & hydraulics design considerations as well as IRC loadings. |
| **CO2** | Lerner will be able to design reinforced and prestressed concrete bridges. |
| **CO3** | Lerner will be able to design steel bridges. |
| **CO4** | Learner will be made aware with seismic consideration in bridge design use of bearing in bridge design. |
| **CO5** | Learner will be able to design bridge foundation. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Introduction to Bridges | Introduction and selection of type of bridges, Geometric and Hydraulic design considerations, Catchment characteristics, Analysis of Runoff Response, runoff concentration, concentration time, economical span, Afflux, Loading and standards for highway and railway bridges, IRC class A, class B, class AA and 70R loadings. | 08 | CO1 |
| 2 | Reinforced and Pre-stressed Concrete Girders | Introduction of Reinforced and Pre-stressed Concrete Bridges: types and standard forms, Balanced cantilever Bridge, Arch bridges, types of arch bridges, Balance cantilever bridges design, Bowstring girder bridges. | 08 | CO2 |
| 3 | Steel Bridges | Steel bridges, Plate Girder Bridge, Web flanges, intermediate stiffeners, Vertical stiffeners, end bearing stiffeners, Box girder bridge, elements and design, Cable Stayed Bridge, Cantilever bridge. | 08 | CO3 |
| 4 | Design of Pier & Abutment | Design of pier and abutments; Force on bearings, types of bearing and design, Seismic design considerations. | 08 | CO4 |
| 5 | Bridge Foundations | Design and Analysis of deep foundation, pile foundation, group of piles efficiency and well foundation. | 08 | CO5 |

**Reference Books:**


C.Vilmaz, S.Wasti Cetin Vlmaz, Analysis and Design of Bridges, CBC Press, (2014).

Raju Krishna, Design of Bridges, Oxford &Ibh Publishing Co. Pvt Ltd (2012).

D. Jhonson Victor, Design of Bridges, Oxford & IBH, (2012).

M.A Jayram, Design of Bridge Structures, PHI,( 2012).


**e-Learning Source:**

https://nptel.ac.in/courses/105105165/

https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/105105165/lec10.pdf

https://lecturenotes.in/m/19545-note-of-bridge-engineering?reading=true

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 1 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| **CO2** | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| **CO3** | 2 | 1 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| **CO4** | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| **CO5** | 2 | 1 | 3 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | | |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

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| **Effective from Session: 2016-17** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE602 | **Title of the Course** | Stability of Structure | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | CE501, CE513 | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To understand the buckling behavior of columns, beams and frames.<br>• To understand the effect of shear and stability analysis of frame for various boundary conditions.<br>• To understand the torsion instability and buckling behavior of thin-walled bars of open cross section.<br>• To understand the buckling of plates and shells, various edge conditions to analyze them by equilibrium approach.<br>• To understand the post buckling behavior of columns, plates and shells under axial and biaxial loading. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Learner will be able to understand the buckling behavior of structural members. |
| **CO2** | Learner will understand the effect of shear and stability analysis of frame for various boundary conditions. |
| **CO3** | Learner will understand the buckling behavior of thin-walled bars of open cross section with given problems. |
| **CO4** | Learner will be able to analyze the plates and shells by equilibrium approach. |
| **CO5** | Learner will be able to understand the post buckling behavior of columns, plates and shells under axial and biaxial loading. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Buckling of Column, Beams and Frames | Buckling of columns, States of equilibrium Classification of buckling problems, concept of equilibrium, Governing equation for columns, Imperfection and vibration approaches to stability analysis - Analysis for various boundary conditions, Effect of shear on buckling. Beam-column, frames. | 08 | CO1 |
| 2 | Torsional Instability | Torsion Buckling: Pure torsion of thin-walled bars of open cross section, non-uniform torsion of thin-walled bars of open cross section. Combined Torsional and flexural instability. | 08 | CO2 |
| 3 | Buckling of Plate | Local buckling of plate elements, Governing differential equation, Buckling of thin plates, various edge conditions. Analysis by equilibrium approach. | 08 | CO3 |
| 4 | Buckling of Shells | Local buckling of shell elements, Analysis by equilibrium approach, Flexural buckling of shells. | 08 | CO4 |
| 5 | Post Buckling Behavior of Structural Element | Post buckling behavior of columns, plates and shells under axial and biaxial loading, Derivation for the buckling loads and for the in-plane stiffness of the plate and shell panels immediately after the instant of buckling. | 08 | CO5 |

**Reference Books:**


Stephen P.Timoshenko, James M Gere, "Theory of Elastic Stability"-2nd Edition, McGraw – Hill, New Delhi. (2009).

Iyenger, N.G.R. "Structural Stability of columns and plates" Affiliated East west press Pvt Ltd., (1990).

Gambhir M.L. " Stability, Analysis & Design of Structure" Springer Science & Business Media,(2004).

Alexandar Chajes, "Principles of Structural Stability Theory" Prentice Hall Publications (1974).


**e-Learning Source:**

https://www.colorado.edu/engineering/CAS/courses.d/Structures.d/IAST.Lect23.d/IAST.Lect23.pdf

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 2 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 |
| **CO2** | 3 | 2 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CO3** | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CO4** | 2 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CO5** | 2 | 3 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2023-24** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE604 | **Title of the Course** | Maintenance, Rehabilitation and Retrofitting of Structure | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 1 | 0 | 4 |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To study the damages, repair and rehabilitation of structures. To impart students, sound knowledge on various causes of failures, detailed assessment procedure for evaluating a distressed structure, materials available for effecting repair and techniques for effective rehabilitation. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Capability to understand the defect of concrete due to climate and suggest remedies. |
| **CO2** | Capability to eliminate construction error and solutions to corrosion problems in steel bars. |
| **CO3** | Skill to perform quality control on concrete. |
| **CO4** | Efficient in repairing the cracks using various techniques. |
| **CO5** | Capability to repair masonry cracks and corrosion of steel. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Properties of Concrete and Weathering Effect on Concrete | Quality assurance for concrete construction, In built concrete properties, strength, permeability, volume changes, thermal properties, cracking. Effects due to climate, temperature, chemicals wear and erosion. | 08 | CO1 |
| 2 | Corrosion Effects and its Prevention | Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, inhibitors, resistant steels, coatings, and catholic protection. | 08 | CO2 |
| 3 | Structural Audit and Maintenance | Inspection, Structural Appraisal, Economic appraisal, components of quality assurance, conceptual bases for quality assurance schemes. Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, expansive cement, polymer concrete, sculpture infiltrated concrete, fibrocement, fiber reinforced concrete. | 08 | CO3 |
| 4 | Materials and Techniques for Repair | Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gummite and concrete epoxy injection, mortar repair for cracks, shoring and underpinning. | 08 | CO4 |
| 5 | Repair, Retrofitting and Rehabilitation | Repair of - stone, brick and block masonry (Cracks, dampness, efflorescence, joint separation; - Flooring - Roofs (sloping, flat, pitched, etc.) - Concrete members due to Steel Corrosion, shear, tension, torsion, compression failure. Rainwater Leakage in Buildings - Leakage in Basement. Control on Termites (White Ants) in Buildings; Fungus Decay of wood works in Buildings | 08 | CO5 |

**Reference Books:**


Dayaratnam.P and Rao.R, "Maintenance and Durability of Concrete Structures", University Press, India, (2007).

Panchdhari A.C., "Maintenance of Building" New Age International (P) Limited, Publishers; First edition (2006).

Venkataraman K., "Maintenance Engineering & Management" Prentice Hall India Learning Private Limited (2007)


**e-Learning Source:**

https://www.sasurieengg.com/e-course-material/CIVIL/IVYear%20Sem%208/CE2071%20RRS.pdf

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 1 | 3 |
| **CO2** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 2 | 2 |
| **CO3** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 1 | 3 |
| **CO4** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 2 | 3 |
| **CO5** | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 1 | 2 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2016-17** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE606 | **Title of the Course** | Design of Tall Buildings | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 1 | 0 | 4 |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To understand the basic concept of tall building.<br>• Able to analysis and design tall structures under wind loads.<br>• Able to analysis and design tall structures under seismic loads.<br>• To understand the codal provision shear wall of tall buildings.<br>• To understand the codal provision of tall buildings. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Learner will develop understanding of tall structures and analysis it for stability. |
| **CO2** | Learner will be able to determine the response of tall building under wind loading. |
| **CO3** | Learner will be able to determine the response of tall building under earthquake loading. |
| **CO4** | Learner will develop understanding of codal provision for shear wall. |
| **CO5** | Learner will be made aware of codal provision for dynamic load and design tall structures. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Stability of Tall Structures | Types of structural systems; types of loads; method of analysis; stability of tall structures; selection of foundation for tall buildings. | 08 | CO1 |
| 2 | Effect of Wind on Tall Buildings | Bluff body aerodynamics; aero-elastic phenomena; wind directionality effects; structural response and design considerations; standard provisions for wind loading. | 08 | CO2 |
| 3 | Effect of Earthquakes on Tall Buildings | Introduction to earthquake engineering and earthquake resistant design of buildings; earthquake motion and response; general principles and design criteria for buildings. | 08 | CO3 |
| 4 | Provision of Shear Wall | Shear in buildings; need and location of shear walls in tall buildings; analysis and design of shear walls. | 08 | CO4 |
| 5 | Codal Provisions | Codal provisions, a seismic design of structures; dynamic analysis; effect of torsion; design of stack like structures; earthquake forces in tall buildings. | 08 | CO5 |

**Reference Books:**


Agarwal, Pankaj; & Shrikhande, Manish; Earthquake Resistant Design of Structures .PHI Publication.2012.

S.Taranath Boca Raton Structural Analysis and Design of tall building CRC Press 2012.

SP 64 (2001): Explanatory Handbook on Indian Standard Code of Practice for Design Loads (Other than Earthquake) for. Buildings and Structures BIS New Delhi.

IS 1893 (Part 1): Criteria for Earthquake Resistant Design of Structures, Part 1: General Provisions and Buildings (Fifth Revision).

Duggal.S.K Earthquake Resistance Design of structure Oxford university Publication.2014.

Ashok K. Jain Reinforced concrete limit state design, Nemchand and Bros. Publication, 2012.


**e-Learning Source:**

https://www.iitk.ac.in/nicee/IITK-GSDMA/EQ21.pdf

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 1 | 3 |
| **CO2** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 2 | 2 |
| **CO3** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 1 | 3 |
| **CO4** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 2 | 3 |
| **CO5** | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 1 | 2 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2016-17** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE607 | **Title of the Course** | Industrial Structures | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 1 | 0 | 4 |
| **Pre-Requisite** | CE512 | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To impart requirement and design concepts of industrial building.<br>• To impart design theories of bunkers and silos.<br>• To introduce learner with classification and design concepts of concrete pipes and steel chimneys.<br>• To impart design concepts large span truss and machine foundation.<br>• To impart design concepts of pipes. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Learner should be able to understand the behavior of industrial building, and also be able to analysis & design industrial structures by knowing its requirements. |
| **CO2** | Learner should able to know the design concepts of bunker and able to design bunkers and silos for given requirements by following guide lines of codes. |
| **CO3** | By knowing the requirements of pipes and chimney learner should able to design aforesaid structures given requirements. |
| **CO4** | Learner should be able to design large span truss by knowing its requirements and geographical conditions and also able to design machine foundation for given conditions. |
| **CO5** | Learner should be able to analyze and design pipes. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Introduction to Industrial Buildings | Types of industrial building, Planning of industrial building. Analysis and design of portal frame and gantry girder for industry. | 08 | CO1 |
| 2 | Bunkers & Silos | Introduction to Bunkers, Types of Bunkers. Design of Concrete Bunkers. Introduction to Silos, Types of Silos, Jenssen's theory, Arry's theory, Design of Concrete Silos by Jensson theory. | 08 | CO2 |
| 3 | Towers & Chimneys | Dimension of Chimney (Stacks), Analysis of stresses in chimney, Design of Steel Chimney. Design of Steel tower. | 08 | CO3 |
| 4 | Large Span Roofs & Machine Foundation | Introduction Large span roof structures, design of Roof Trusses, Structural aspect of machine foundation. | 08 | CO4 |
| 5 | Pipes | Classification of Pipe, Design principle, Reinforcement in pipe, Test on pipe, Design of concrete pressure pipes. | 08 | CO5 |

**Reference Books:**


Duggal S. K. , "Limit State Design of Steel Structures", Tata Mc-Graw-Hill Publishing Company. 2nd edition ( 2016).

Punmia, B.C. Jain A.K, "Steel Structures Design and Practice", Laxmi Publications (P) Ltd.2nd edition (reprint 2011).

N. Krishna Raju, "Structural Design and Drawing Reinforced Concrete and Steel", University Press 2nd edition (2012).

N Krishna Raju "Advance Reinforced Concrete Design", CBS publication and Distributors Pvt. Ltd 2nd edition(reprint 2014).

Vazirani, Ratwani & Kumar "Design and Analysis of Steel Structure", Khanna Publishers, New Delhi 18th revised edition (2012)


**e-Learning Source:**

https://nptel.ac.in/courses/105106113/3

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CO2** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 |
| **CO4** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CO5** | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2016-17** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE608 | **Title of the Course** | Prefabricated Structures | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To get knowledge about various prefabrication systems and structural schemes.<br>• To know about design consideration, Economy of prefabrication and prefabrication of load bearing members.<br>• To design the Pre-stressed concrete sections.<br>• To design for shear, torsion, bend and bearing and application of prestressing of roof members.<br>• To learn about production, Transportation and erection of Form-work and dimension tolerances of shuttering and mould design. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | One will get knowledge about various prefabrication systems and structural schemes. |
| **CO2** | Learner will learn about design consideration, Economy of prefabrication and prefabrication of load bearing members. |
| **CO3** | Learner will be able to design the Pre-stressed concrete section. |
| **CO4** | Learner will learn about application of prestressing of roof members and able to design for shear, torsion, bend and bearing. |
| **CO5** | Learner will learn about production, Transportation and erection of Formwork and dimension tolerances of shuttering and mould design. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Introduction to Prefabrication | Need of prefabricated structural, Its aim, advantages & disadvantages, types of prefabrication, Material used of Prefabrication. | 08 | CO1 |
| 2 | Modular Co-ordination in Prefabricated Structures | Modular co-ordination, components, prefabrication systems and structural schemes, Design considerations, Economy of prefabrication: prefabrication of load bearing members. | 08 | CO2 |
| 3 | Design of Prestressed Concrete Sections | Disuniting of structures; Design of cross section of load carrying members; structural behavior of precast structures, Handling and erection stresses, Design of section for flexure, Axial tension, Compression. | 08 | CO3 |
| 4 | Design for Shear, Torsion, Bend and Bearing | Application of prestressing of roof members; floor systems, Two-way load bearing walls, wall panels, hipped plate and shell structures, Dimensioning and detailing of joints for different structural connections; constriction and expansion joints. | 08 | CO4 |
| 5 | Fabrication and Erection of Formwork | Production, Transportation and Erection; Organization of production, Storing and erection equipments, Shuttering and Mould design-Dimensional tolerances, Erection of RCC structures, Total prefabricated buildings. | 08 | CO5 |

**Reference Books:**


Jain A.K., “Reinforced concrete design, limit state Method”, Nem Chand & Bros.; Seventh edition (2012)

Punmia B.C and Jain A.K, “Reinforced concrete structures(Vol.2)”, Laxmi Publications, Fifth Edition (2003)

Praveen Nagarjan, “Prestessed concrete design” Pearson Education New Delni(2013)

Garold (Gary) Oberlender and Robert Peurifoy “Formwork for Concrete Structures” McGraw Hill Professional,(2010)

IS 456-2000 Indian Standard “Plain & Reinforced Concrete-code of practice”, BIS, New Delhi

IS 159166-2010 Building Design and Erection using Prefabricated Concrete -code of practice”, BIS, New Delhi


**e-Learning Source:**

https://civildigital.com/prefabricated-structures-prefabrication-concept-components-advantages-ppt/

https://www.srividyaengg.ac.in/coursematerial/Civil/103823.pdf

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **CO2** | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **CO3** | 2 | 2 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **CO4** | 3 | 2 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **CO5** | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2016-17** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE611 | **Title of the Course** | A Seismic Design of Structures | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 1 | 0 | 4 |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To impart requirement and design concepts of industrial building.<br>• To impart design theories of bunkers and silos.<br>• To introduce learner with classification and design concepts of concrete pipes and steel chimneys.<br>• To impart design concepts large span truss and machine foundation. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Learner should be able to understand the behavior of industrial building, and also be able to analysis & design industrial structures by knowing its requirements. |
| **CO2** | Learner should able to know the design concepts of bunker and able to design bunkers and silos for given requirements by following guide lines of codes. |
| **CO3** | By knowing the requirements of pipes and chimney learner should able to design aforesaid structures given requirements. |
| **CO4** | Learner should be able to design large span truss by knowing its requirements and geographical conditions and also able to design machine foundation for given conditions. |
| **CO5** | Learner will be able to understand Indian Standard guidelines and implement it in seismic design. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Characteristic of Earthquakes | Earthquake terminology, magnitude, intensity, measurement of ground motion, frequency-magnitude relationship. Strong ground motion: Acceleration time histories, peak parameters (peak ground acceleration / velocity / displacement). Earthquake induced Liquefaction of soil. | 08 | CO1 |
| 2 | Structural Idealization for Dynamic Analysis | Earthquake analysis of structures: Idealization of structures, Free vibration of lumped Multiple Degree of freedom system, response spectrum analysis, equivalent force concepts, torsionally coupled systems. | 08 | CO2 |
| 3 | Concepts of Earthquake Resistant Design | Ductility requirement reduction factor, over-strength, response reduction factor, design response spectrum, lateral stiffness, building configuration, base isolation | 08 | CO3 |
| 4 | Design of Shear Wall | Design of shear wall. Modern techniques in a seismic design. | 08 | CO4 |
| 5 | IS Codes for Seismic Design of Structures | Building codes: Performance of buildings in past earthquakes, historical perspective of code development, Indian code (IS: 1893), Retrofitting and strengthening of structures (IS: 13935). Detailing for reinforced concrete and masonry buildings, provisions of IS: 13920, IS: 4326, IS: 13927, IS: 13928 | 08 | CO5 |

**Reference Books:**


R.W. Clough and J. Penzein, Dynamics of structures, second edition, McGraw Hill. International edition

M. Paz, Dynamics of structures, fifth edition, CBS pub.

A.K. Chopra, Dynamics of structures- Theory and application to earthquake engineering, fifth edition PHI.

T. Pauley and M.S.N. Priestly, Seismic design of reinforced concrete and masonry buildings. John Wiley and sons

S.R.Damodarasamy and S.Kavitha , Basics of Structural Dynamics and A Seismic Design, PHI


**e-Learning Source:**

https://www.iitk.ac.in/nicee/wcee/article/11_2001.pdf

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CO2** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 |
| **CO4** | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |
| **CO5** | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 2 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2016-17** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE612 | **Title of the Course** | Computer Aided Design in Structural Engineering | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To develop the python basic programming skill in order to carry our engineering problems.<br>• To develop the skill in order to work on EXCEL efficiently in order to carry our engineering problems.<br>• To utilize the programming in order to perform analysis and design in structural engineering.<br>• To utilize the excel in order to perform analysis and design in structural engineering.<br>• To familiarize automation in structural engineering. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Capability to execute the programming in python language. |
| **CO2** | Skill to work on EXCEL and capability to perform statistical analysis on a data efficiently. |
| **CO3** | Efficient in structural analysis problems using python language. |
| **CO4** | Efficient in mix proportioning and structural designing using excel. |
| **CO5** | Capability to perform automation using machine learning techniques in structural engineering. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Introduction to Computing Environment and Python Programming | Introduction to computer aided design- An over view- computer as a design medium hardware - components of a computer programming languages and analysis software. Python Programming language- Introduction- Control structures-If statement -Switch statement-loops-nested loops-while and for, Do-While-continue statement-Go to statement-Examples. Python Programming Language- Arrays - One dimensional Arrays- Two Dimensional Arrays and arrays- Matrix manipulations using arrays- data files- basic operations-reading and writing and file accessing files-examples. | 08 | CO1 |
| 2 | Excel Application in Engineering | Tables and charts - basic elements of Excel - Conditional formatting - Logic and nested functions - Organizing data - Advanced table formatting - Worksheets management - Mathematical functions - Database functions - Working with references on different worksheets - Analyzing data - Define and use cells names - Other What-if analysis tools – Text functions - Lookup and reference functions - Data validation - Auditing tools - Data gathering and automations - Importing and linking data - Advanced copy and paste options. | 08 | CO2 |
| 3 | Application in Structural Engineering-I | Uses of Software packages in the area of Structural Engineering. Program using arrays and functions for matrix manipulation using programming. Application of Finite Element method for solving Structural Engineering problems. Program for the analysis of simply supported beam- continuous beam- multi-storeyed space frame. | 08 | CO3 |
| 4 | Application in Structural Engineering-II | Design of slabs- beam- column and footing as per Indian Standard code using Excel. Concrete mix proportioning and plotting distribution curve on Excel. Estimation of a building on Excel. | 08 | CO4 |
| 5 | Machine Learning in Structural Engineering | Introduction to machine learning, Types of machine learning, Uncertainty in structural designing and mix proportioning- Dealing uncertainty in structural engineering with machine learning. Automation in structural engineering. | 08 | CO5 |

**Reference Books:**


David.F. Rogers. Mathematical elements for computer graphics, McGraw Hill 2005.

David F. Rogers. Elements of computer graphics, Mc Graw Hill International 2002.

Martin C. Brown, Python: The Complete Reference, Mc Graw Hill International 2018.

Mark Taylor, Learn Microsoft Excel at Advanced Level, Paragon Pub., 2009.

Brian R. Hunt, A Guide to MATLAB: For Beginners and Experienced Users, Cambridge University Press, 2006.


**e-Learning Source:**

https://nptel.ac.in/courses/117106113/34

https://nptel.ac.in/courses/106105166/26

| | Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO** / **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 0 | 3 | 3 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 |
| **CO2** | 0 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 |
| **CO3** | 0 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 |
| **CO4** | 0 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 |
| **CO5** | 0 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2020-21** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE613 | **Title of the Course** | Prestressed Concrete | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | Nil | **Co-requisite** | Nil | | | | |
| **Course Objectives** | • To impart concepts of pre-stressing in concrete and their types.<br>• To impart importance's of control deflection.<br>• To impart behavior and design concept of pre-stressed concrete flexure members.<br>• To impart concept of shear, bond and bearing stress in prestress concrete member.<br>• To impart concept and behavior of full and partial prestressed members | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Learner should know the concepts of pre-stressing in concrete structures as well an able to formulate losses in prestressed concrete. |
| **CO2** | Learner should know the factors influencing deflection in prestress structures and able to calculate deflection of prestressed concrete member by using code provision for given conditions. |
| **CO3** | Learner will be able to understand behavior of prestressed flexure members and able to design flexure member by using code provision for given conditions. |
| **CO4** | Learner will be able to understand concepts of transmission length, bond, bearing and shear stress in prestressed members as well as able to design of prestress member for bond, bearing and shear forgiven requirement. |
| **CO5** | Learner will be able to understand the behavior and design concept of full and partial prestressed members and able to design member for given requirements by following the guideline of Indian codes. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Introduction to Prestressed Concrete | Pre-stressed concrete, basic concept, prestressing material and prestressing systems; losses of prestress, End anchorage and cable layouts. | 08 | CO1 |
| 2 | Deflection of Prestressed Concrete Member | Importance of control of deflection, Factor influencing deflection, Deflection of cracked and uncracked member | 08 | CO1 |
| 3 | Design of Flexural Member | Flexure strength of prestressed concrete sections, Design of section for flexure, analysis and design of prestressed concrete flexure members, simply supported beams and slabs | 08 | CO1 |
| 4 | Design for Shear, Torsion, Bend and Bearing | Shear and principle stress in prestress concrete member, design of shear reinforce ment, transmission length, design of prestress member for bond and bearing | 08 | CO1 |
| 5 | Design of Tension and Compression Member | Analysis and design of prestressed compression and tension concrete members. Design of partial pre-stress pre tensioned poles, design of pre-stressed concrete piles. | 08 | CO1 |

**Reference Books:**


Jain A.K., "Reinforced concrete design, limit state Method", Nem Chand & Bros.; Seventh edition (2012)

N Krishna Raju. "Prestressed Concrete" McGraw Hill Education; Fifth Edition (2012)

Praveen Nagarjan, "Prestessed concrete design" Pearson Education New Delni(2013)

IS 456-2000 Indian Standard "Plain & Reinforced Concrete-code of practice", BIS, New Delhi


**e-Learning Source:**

https://www.nptel.ac.in/courses/105106117/

https://www.nptelvideos.in/2012/11/prestressed-concrete-structures.html

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 |
| **CO2** | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 3 |
| **CO3** | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 3 |
| **CO4** | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 3 |
| **CO5** | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 3 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2016-17** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE616 | **Title of the Course** | Directed Study | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | **0** | **0** | **0** | **4** |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • To make learner aware about the latest technology and engineering practices in industries. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Awareness regarding the latest technology, engineering methodology and practices being used in industries. |

| **Unit No.** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|
| 1 | Undergo industrial training in any respective industry in order to get familiar with the latest technology, engineering techniques and practices being used in the industry. Have to absorb some skill from the training identifying the area of improvement. The concepts/skills must be clearly understood and presented by the student. A hard copy of the report should be submitted to the Department after the completion of directed study. | 03hrs | CO1 and CO2 |

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 3 | 3 | 0 | 3 | 3 | 3 |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

**Integral University, Lucknow**

| **Effective from Session: 2019-20** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CE699 | **Title of the Course** | M. Tech Dissertation | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III and IV | **0** | **0** | **0** | **20** |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | To enhance the writing skill for research paper and dissertation | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Capability to work independently on a research-based problem |
| **CO2** | Skill to perform review of available literature effectively to present research gap. |
| **CO3** | Aptitude to plan methodology for the attainment of various research objectives. |
| **CO4** | Competency to apply of various engineering and technological tools to carry research. |
| **CO5** | Ability to conclude work using critical thinking |
| **CO6** | Proficiency in preparing presentation and report. |

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 0 | 2 |
| **CO2** | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 0 | 1 |
| **CO3** | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 3 | 0 | 3 | 0 | 2 |
| **CO4** | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 1 |
| **CO5** | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 0 | 1 |
| **CO6** | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 0 | 1 |

**1- Low Correlatio0n; 2- Moderate Correlation; 3- Substantial Correlation**