

SYLLABUS

OF

M. TECH
(Structural Engineering)

I YEAR

(CBCS)

**DEPARTMENT OF CIVIL
ENGINEERING**

**INTEGRAL UNIVERSITY
LUCKNOW**

SYLLABI AND EVALUATION SCHEME

M.Tech. (Structural Engineering)

(w.e.f. 2020-21)

Semester – I

S. No.	Course Category	Code No	Name of Subject	Periods			Credits C	Evaluation Scheme			Exam ESE	Subject Total
				L	T	P		Continuous Assessment (CA)				
				UE	TA	Total						
1	DC	CE501	Theory of Elasticity and plasticity	3	1	-	4	40	20	60	40	100
2	DC	CE502	Advanced Structural Analysis (Matrix Approach)	3	1	-	4	40	20	60	40	100
3	DC	CE503	Advanced Concrete Design	3	1	-	4	40	20	60	40	100
4	DE		Elective -I	3	1	-	4	40	20	60	40	100
5	DC	CE509	Structural Engg Lab	-	-	3	2	40	20	60	40	100
Total							18					500

Semester – II

S. No.	Course Category	Code No	Name of Subject	Periods			Credits C	Evaluation Scheme			Exam ESE	Subject Total
				L	T	P		Continuous Assessment (CA)				
				UE	TA	Total						
1	DC	CE510	Structural Dynamics	3	1	-	4	40	20	60	40	100
2	DC	CE511	Numerical Analysis and Finite Element Method	3	1	-	4	40	20	60	40	100
3	DC	CE512	Advanced Steel Structures	3	1	-	4	40	20	60	40	100
4	DC	CE552	Research Methodology	3	1	-	4	40	20	60	40	100
5	DC	CE514	Seminar	-	-	3	2	-	-	60	40	100
Total							18					500

UE- Unit Exam, **TA-** Teacher Assessment; **ESE** – End Semester Examination.

Note: Duration of ESE shall be 03 (Three) hours per subject

M. Tech (Structural Engineering)

List of the Elective Paper:

Elective – I

CE504	Concrete Technology
CE505	Design of foundation structures
CE506	Design of steel Concrete composite Structures
CE513	Theory of Plates and Shell

Elective – II

CE601	Design of Bridges
CE602	Stability of Structures
CE603	Maintenance and Rehabilitation of Structures

Elective – III

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

Elective – IV

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

TA- Teacher Assessment; ESE – End Semester Examination; CT- Cumulative Test.

Note : Duration of ESE shall be 03 (Three) hours per subject.



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE501	Title of the Course	Theory of Elasticity and Plasticity	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To make learner understand the concept of Elasticity & Plasticity of material. 						

Course Outcomes	
CO1	Knowing the basics of elastic theory, learner will understand the concept of stress tensor & stress Invariants and be able to perform axis transformation in Cartesian coordinates.
CO2	In two dimensional Cartesian coordinate system, learner will understand about bi-harmonic equation for plane stress and be able perform elastic calculation of stress and strain.
CO3	In two dimensional Polar coordinate system, learner will understand equilibrium and compatibility equations and be able perform elastic calculation of stress and strain.
CO4	Knowing the plastic behavior, learner will understand analysis principle and be able to establish failure criteria.
CO5	To make learner understand bending behavior of beam in plastic torsion and able to perform deformation analysis of it.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Analysis of stress and strain, Stress strain relationship. Generalized Hooke's Law. Plane stress and plane stress plane strain.	08	CO1
2	Stress and Strain in Cartesian Co-Ordinates	Two dimensional problems in Cartesian co-ordinates for simple problems of structures.	08	CO2
3	Stress and Strain in Polar Co-Ordinates	Two dimensional problems in polar co-ordinates for simple problems of structures.	08	CO3
4	Introduction to Plasticity	Introduction to problems in plasticity. Physical assumption- criterion of yielding, yield surface, Flow rule (plastic stress strain relationship).	08	CO4
5	Elasto-Plasticity	Elastic plastic problems of beams in bending- plastic torsion.	08	CO5

Reference Books:

Timoshenko, S. and Goodier T.N. "Theory of Elasticity" Mc Graw Hill Book Co. Newyork. II Edition 1988.

Chwo P.C. and pagano, N.J. "Elasticity Tensor, Dyadic and Engineering applications" D.Van Nestrand Co. In Co. 1967.

Chenn, W.P and Henry D.J. "plasticity for structural Engineers", Springer Verlag New Yark 1988.

Sadhu Singh, "Theory of Elasticity", Khanna publishers, New Delhi 1988.

Verma PDS, "Theory of Elasticity", Vikas publishing Pvt. Ltd. New Delhi – 1997.

Sadhu Singh, "Theory of plasticity", Khanna publ

e-Learning Source:

<https://nptel.ac.in/courses/105105177/>

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE502	Title of the Course	Advanced Structural Analysis (Matrix Approach)	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> • To developed understanding of structural analysis by matrix approach. • To analyze the structures using displacement methods and force methods. 						

Course Outcomes	
CO1	To understand the basis methods of structural analysis and basic concepts of matrix approach.
CO2	Learner will be able to formulate displacement matrix and analyses continuous beams, rigid & pin jointed plane frames by displacement method.
CO3	Learner will be able to formulate flexibility matrix and analyze rigid jointed plane frames by force method.
CO4	Learner will be able to analyze rigid & pin jointed space frames & space using displacement method.
CO5	Learner is familiarized with static condensation procedure and will be able to analyses large structures using sub structuring technique.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Review of Basic Concept in Structural Analysis & Introduction to Matrix Method of Analysis	Basic method of Structural Analysis, Flexibility & Stiffness matrices.	08	CO1
2	Displacement Method -2D Analysis	Introduction to Matrix Methods- displacements formulation analysis of continuous beams, rigid and pin jointed plane-frames.	08	CO2
3	Force Method	Matrix flexibility methods- general formulation-application to plane rigid jointed plane frame	08	CO3
4	Displacement Method -3D Analysis	Displacement method for three dimensional structure- analysis of pin-jointed and rigid jointed space frames.	08	CO4
5	Special Problems and Techniques	Analysis of large structures- sub-structuring static condensation procedure- Simple problems only.	08	CO5

Reference Books:

- Coates, R.C., Coutie M.G., and Kong, F.K, Structural Analysis, John Wiley and Sons, 1979.
- Mc Guire, W., and Gallagher, R.H., Matrix Structural Analysis, John Wiley and Sons, 1979.
- John L. Meek., Matrix structural Analysis, Mc Graw Hill Book Company, 1971.
- G.S.Pandit & S.P.Gupta, Advance Structural Analysis (A Matrix Approach) Tata Mc Graw Hill,

e-Learning Source:

<https://nptel.ac.in/courses/105106050/>

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2019-20							
Course Code	CE503	Title of the Course	Advanced Concrete Design	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	CE302	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To Developed the Basic Knowledge Required for Designing of Flat and Grid Slabs, Shear Wall, Deep Beam and Application of Ductile Detailing. 						

Course Outcomes	
CO1	Understand the background of structural concrete and behavior of beam and slab.
CO2	Able to design structure for serviceability condition (Deflection and Crack width).
CO3	Able to design deep beam and Grid floor.
CO4	Able to design flat slab with different support conditions.
CO5	Understand the method of field control of concrete and concepts of detailing for ductility.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Review of Limit State Design of Beam, Column & Slab	Review of limit state design of beam, slab, ordinary column & slender column, Design of ordinary R.C wall.	08	CO1
2	Introduction to Deflection & Crack Width	Calculation of deflection and crack width according to IS 456-2000, Design of spandrel beams.	08	CO2
3	Design of Grid Floor, Shear Wall and Corbels	Types of shear walls, Design of Shear wall, Design of Corbels, Design of Grid floors.	08	CO3
4	Design of Flat Slabs, Plates and Deep Beams	Design of flat slabs and flat plates according to ACI method, Design of deep beams	08	CO4
5	Utility of Ductile Detailing and Fire Resistant Building	Detailing for ductility, fire resistance of buildings, field control of concrete.	08	CO5

Reference Books:	
Purushothaman, P, Reinforced Concrete Structure Structural Elements: Behavior Analysis and Design, Tata Mc Graw Hill, 1986.	
Varghese, P.C., Limit State Design of Reinforced Concrete, prentice Hall of India, 1995.	
Krishna Raju, N. Advanced Reinforced Concrete Design, CBS publishers and Distributors, 1986.	
N. Subramanlan, Design of Reinforced Structural Oxford University Press 2014.	
Ashoke K. Jain, Reinforced Concrete Limit State Design, New Chand & Bros. Roorkee 2012	
e-Learning Source	
https://nptel.ac.in/downloads/105105104/	

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2019-20							
Course Code	CE504	Title of the Course	Concrete Technology	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To understand the types and roles of concrete materials with in depth understanding of manufacturing and hydration of cement. To develop the ability to recognize the properties fresh and hardened concrete and to perform nondestructive tests. To perform Mix Proportioning as per IS 10262-2016. To familiarize with special types of concrete and quality control procedures. 						

Course Outcomes	
CO1	Capability to perform tests on concrete materials as per Indian Standard and skill to manage the manufacturing of cement with in-depth knowledge of process, reaction and hydration of cement.
CO2	Quality and properties assessment of fresh concrete by performing the required tests as per Indian Standard.
CO3	Quality and properties assessment of hardened concrete by performing the required tests as per Indian Standard.
CO4	Capability to perform Mix proportioning as per IS10262 using the materials available near the concerned site and demand.
CO5	Ability to perform the quality checks on concrete structures with the knowledge of special types of concretes.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Cement and Aggregates	Cement, Grade of cement, Chemical composition, testing of concrete, Hydration of cement, structure of hydrated cement. Aggregates classification, IS specifications, properties, Grading, Methods of combining aggregates, specified grading, Testing of aggregates.	08	CO1
2	Fresh Concrete and Admixtures	Properties of fresh concrete: basics regarding fresh concrete – mixing, workability, placement, consolidation, and curing, segregation and bleeding. Chemical Admixtures: types and classification; actions and interactions; usage; effects on properties of concrete. Mineral Admixtures: Flyash, ground granulated blast furnace slag, rice-husk ash and silica fume; effects on properties of concrete; advantages and disadvantages.	08	CO2
3	Hardened Concrete and Durability	Properties of hardened concrete: Strength- compressive tensile and flexure - Elastic properties - Modulus of elasticity – Sampling - Creep and shrinkage. Durability of concrete: Durability concept; factors affecting, reinforcement corrosion; fire resistance; frost damage; sulfate attack; alkali silica reaction; concrete in sea water, statistical quality control, acceptance criteria as per BIS code.	08	CO3
4	Mix Proportioning	Principle of concrete mix design, Concrete mix proportioning using IS 10262. Ready mix concrete and its merits & demerits.	08	CO4
5	Special Concrete & Concreting Methods	Light weight concrete, Fly ash concrete, Fiber reinforced concrete, polymer Concrete, Super plasticized concrete, Other special concrete, Epoxy resins and Applications High performance concrete, Extreme weather concreting, special concreting methods, vacuum dewatering underwater concrete, special form work.	08	CO5

Reference Books:

Neville, A.M., properties of Concrete, pitman publishing Limited, London.

Shetty M.S., Concrete Technology, S. Chand and Company Ltd. Delhi.

Rudhani G., Light Weight Concrete Academic Kiado, Publishing Home of Hungarian Academy of Sciences, 1963.

e-Learning Source:

<https://nptel.ac.in/courses/105102012/>

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	2	2	0	0	2	0	0	0	0	3	2	3
CO2	3	0	0	2	0	0	0	0	0	0	0	3	2	3
CO3	3	0	0	2	0	0	0	0	0	0	0	3	2	3
CO4	3	0	3	1	0	2	1	3	0	0	0	3	1	3
CO5	3	0	0	0	0	2	0	3	0	0	0	3	0	3

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE505	Title of the Course	Design of Foundation Structures	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To impart knowledge of method of soil investigation for determining geotechnical design parameters and to familiarize the students for design of different type of foundation. 						

Course Outcomes	
CO1	Structure of Environment – interaction between biological and chemical components, Basics of hydrosphere, atmosphere, lithosphere, biosphere, scope and importance of environmental science..
CO2	Student will be able to explain the interaction between different species of the environment.
CO3	Student will learn about different microorganisms present in environment and their significance.
CO4	Student will be able to understand the basics of different enzymes reactions and the basic of aquatic chemistry.
CO5	Student will be able to understand the basics of atmospheric chemistry.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Soil Investigation report for design of foundation structures. General principles of design of reinforced concrete shallow and deep foundations.	8	CO1
2	Design of Shallow and Deep Foundations	Shallow foundations- Beams on elastic foundations, Design of isolated & rafts foundation, Basement design, Deep foundations- Load carrying capacity of different types of piles and detailing of reinforcements according to IS 2911- Design of pile caps.	8	CO2
3	Design of Pile Foundations	Design of eccentric loaded piles, Laterally loaded piles and their efficiency, Design of pile caps.	8	CO3
4	Design of Well Foundations	Deep foundation- Design of well foundation on cohesive & no cohesive soils, Method of constructions.	8	CO4
5	Tower Foundations	Design of foundations for towers- Structural design of support for foundation excavation, design of ground anchors.	8	CO5

Reference Books:

Thomlinson, M.J. and Boorman.R., “Foundation design and construction”, ELBS Longman VI Edt. 1995.
 Nayak, N.V., “Foundation Design manual for practicing Engineers”. Dhanpat Rai and Sons, 1982.
 Winterkorn H.F., and Fang H.Y., “Foundation Engineering Hand book –Van Nostrard – Reinhold 1976.

e-Learning Source:

<https://nptel.ac.in/downloads/105101083/>

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE506	Title of the Course	Design of Steel Concrete Composite Structure	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To get knowledge about composite section of steel-concrete. To understand the steel sandwich construction. To study the behavior and to design the composite beam and column sections and composite trusses. To know about different types of connections in composite structures and to design it. To understand the behavior of box girder bridges and its design concept 						

Course Outcomes	
CO1	With given problem learner will get knowledge about composite section of steel-concrete.
CO2	Learner will understand the steel sandwich construction.
CO3	Learner will understand the behavior of composite section and will learn how to design composite trusses.
CO4	Learner will get knowledge about different types of connections in composite structures.
CO5	With given problem learner will be able to understand the behavior of box girder bridges and learn how to design it.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Introduction to steel concrete composite construction, theory of composite structures, introduction to steel Concrete – Steel sandwich construction.	8	CO1
2	Design of Composite Columns	Different type of composite columns, behavior of composite columns, design of steel concrete composite columns.	8	CO2
3	Design of Composite Beams & Trusses	Different type of composite beams, behavior of composite beams, design of composite beams. Behavior of trusses, design of trusses.	8	CO3
4	Design of Connections	Types of connections – Design of connections in the composite structures- Shear connections- Design of connections in composite trusses.	8	CO4
5	Composite Box Girder Bridges	Introduction – Behavior of box girder bridges – Design concepts.	8	CO5

Reference Books:

Neville, A.M. , Properties of concrete, Pitman publishing Limited , London.

Shetty M.S. , Concrete Technology, S. Chand and Company Ltd. Delhi.

Rudhani G., Light Weight Concrete Academic Kiado, publishing Home of Hungarian Academy of Sciences, 1963.

e-Learning Source:

<https://nptel.ac.in/courses/105106112/>

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE513	Title of the Course	Theory of Plates and Shells	L	T	P	C
Year	I	Semester	I	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To learn about the behavior of plates, various boundary conditions and solution of plates. To analyze plates of various shape and to design them. To analyze the cylindrical shells and to get numerical solutions. To know about approximate design methods for doubly curved shells, Design criteria, code specification and stability consideration. To study the structural behavior of folded plates and its design considerations. 						

Course Outcomes	
CO1	Learner will learn about the behavior of plates, various boundary conditions and solution of rectangular and Circular plates.
CO2	One will be able to analyze plates of various shape and can design it.
CO3	Learner will be able to analyze the cylindrical shells and can get numerical solutions.
CO4	One will get knowledge about design methods for doubly curved shells, Design criteria and stability consideration.
CO5	Learner will learn structural behavior, method of analysis of folded plates and its design considerations.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction of Plates	Plates; basic concept, governing equations, boundary conditions, plates of various shapes.	8	CO1
2	Behavior of Plates	Solution of rectangular and circular plates by classical methods, numerical methods, design criteria.	8	CO2
3	Behavior of Shells	Shells; basic concepts, membrane and bending Analysis of cylindrical shells, shell of revolution, edge perturbations and secondary stresses; numerical solutions.	8	CO3
4	Doubly Curved Shells	Approximate design methods for doubly curved shells; design criteria, code specification and parametric proportioning, stability considerations.	8	CO4
5	Folded Plates	Folded plates; forms, structural action, method of analysis, design considerations.	8	CO5

Reference Books:

- S. Timoshenko – Theory of plate and shells.
 L.G. Jaeger – Elementary theory of elastic plates.
 G. Ramaswamy – Design of Concrete Shells.
 Ramchandran - J.- Thin Shells –Theory and problems.

e-Learning Source:

<https://nptel.ac.in/courses/105105041/m6132.pdf>

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2015-16							
Course Code	CE509	Title of the Course	Structural Engineering Laboratory	L	T	P	C
Year	I	Semester	I	0	0	3	2
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To understand the types and roles of concrete materials with in depth understanding of manufacturing and hydration of cement. To develop the ability to recognize the properties fresh and hardened concrete and to perform nondestructive tests. To perform Mix Proportioning as per IS 10262-2016. To familiarize with special types of concrete and quality control procedures. 						

Course Outcomes	
CO1	Capability to perform tests on concrete materials as per Indian Standard to retrieve data for mix proportioning.
CO2	Capability to perform Mix proportioning as per IS10262 to meet concrete performance.
CO3	Quality assessment of mix proportioning by performing the required tests on fresh concrete as per Indian Standard.
CO4	Quality assessment of mix proportioning by performing the non-destructive tests on hardened concrete as per Indian Standard.
CO5	Quality assessment of mix proportioning by performing the destructive tests on hardened concrete as per Indian Standard.

Unit No.	Unit Title	Content of Unit	Contact Hrs.	Mapped CO
1	Exercise 1	Testing of fine and coarse aggregate. (Specific Gravity, Water Absorption and Sieve Analysis)	03	CO1
2	Exercise 2	Concrete mix design.	03	CO2
3	Exercise 3	Properties and testing of fresh concrete. (Workability by Slump, Bleeding and Honey Combing Visually)	03	CO3
4	Exercise 4	Non- destructive testing of hardened concrete. (Rebound Hammer Test)	03	CO4
5	Exercise 5	Destructive testing of hardened concrete. (Compression Test of Cube, Flexure Test of Prism)	03	CO5
6	Exercise 6	Plotting of distribution Curve.	03	CO5
7	Exercise 7	Strength, fracture and micro structural characteristics of mild steel.	03	CO4

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	2	0	0	3	3	0	3	3	3
CO2	0	0	0	3	3	2	0	0	3	3	0	3	3	3
CO3	0	0	0	3	3	2	0	0	3	3	0	3	3	3
CO4	0	0	0	3	3	2	0	0	3	3	0	3	3	3
CO5	0	0	0	3	3	2	0	0	3	3	0	3	3	3

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE510	Title of the Course	Structural Dynamics	L	T	P	C
Year	I	Semester	II	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To developed the concept of structural dynamics. To analysis and design structures subjected to dynamics loading. 						

Course Outcomes	
CO1	Lerner will be able to identify, formulate and solve free response of single degree freedom system.
CO2	Lerner will be able to identify, formulate and solve forced response of single degree freedom system.
CO3	Lerner will be able to determine natural frequencies & modes shapes of multi degree of freedom system by approximate methods
CO4	Lerner will be able to determine response of lumped multi degree of freedom system using normal mode theory & numerical integration scheme
CO5	Lerner will be made aware of continues system and analysis of tall structures under dynamics loading.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction & Free Vibration of Single Degree of Freedom System	Basic compets of vibration, dynamic loading, types of vibration and ground motions. Free vibration of single degree of freedom system.	08	CO1
2	Forced Vibrations of Single Degree of Freedom System	Forced vibrations of single degree of freedom system, response to harmonic, periodic, impulsive and general dynamic loading, response of SDOF to earthquake.	08	CO2
3	Free Vibration of Multi Degree of Freedom System	Free vibration of lumped multi degree of freedom system. Approximate methods for obtaining natural frequencies and mode shapes.	08	CO3
4	Lumped Multi Degree of Freedom System	Frequency domain analysis of lumped multi degree of freedom system using normal mode theory, Time domain analysis using Numerical Integration Scheme.	08	CO4
5	Free and Forced Vibrations of Continuous System	Free and forced vibrations of continuous system; Dynamic analysis of tall and massive structures.	08	CO5

Reference Books:	
Glen V.Berg – Element of structural Dynamics.	
Agarwal, Pankaj; & Shrikhande, Manish; Earthquake Resistant Design of Structures.	
Paz, Mario; Structural Dynamics – Theory and Computations.	
Chopra, Anil Kumar; - Dynamics of Structures.	
Damodar Swami - Structural Dynamics & A seismic Design.	
e-Learning Source:	
https://nptel.ac.in/courses/105106176/	
https://nptel.ac.in/downloads/105105104/	

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

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CE511	Title of the Course	Numerical Analysis and Finite Element Method	L	T	P	C
Year	I	Semester	II	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To understand the types and roles of concrete materials with in depth understanding of manufacturing and hydration of cement. To develop the ability to recognize the properties fresh and hardened concrete and to perform nondestructive tests. To perform Mix Proportioning as per IS 10262-2016. To familiarize with special types of concrete and quality control procedures. 						

Course Outcomes	
CO1	Capability to perform tests on concrete materials as per Indian Standard and skill to manage the manufacturing of cement with in-depth knowledge of process, reaction and hydration of cement.
CO2	Quality and properties assessment of fresh concrete by performing the required tests as per Indian Standard.
CO3	Quality and properties assessment of hardened concrete by performing the required tests as per Indian Standard.
CO4	Capability to perform Mix proportioning as per IS10262 using the materials available near the concerned site and demand.
CO5	Ability to perform the quality checks on concrete structures with the knowledge of special types of concretes.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Numerical Solution to Linear Equation	Newton-Raphson Method, Regula-Falsi Method, Gauss-Elimination Method, Gauss-Jordan Method, Gauss-Jacobi Method.	08	CO1
2	Numerical Solution to Integration & Ordinary Differential Equations	Trapezoidal Rule for Single & Multiple Integration, Simpson's 1/3rd Rule, Simpson's 3/8th Rule, Simpson Double integration, Taylor's Series Method, Runge-Kutta Method.	08	CO2
3	Interpolation & Boundary Value Problems	Gauss's Forward Interpolation, Gauss's Backward Interpolation, Divided Differences Method, Finite Difference Method, Galerkin's Method.	08	CO3
4	Finite Element Methods -1	Introduction of FEM, Various types of Finite Elements, Stiffness Matrix of Spring Elements, Problems on Assemble of Spring Elements, Derivation of Stiffness Matrix of Bar Elements, Problems on Assemble of Bar Elements.	08	CO4
5	Finite Element Methods -2	Shape Function of Beam Elements, Problem on Beam Elements, Global & Local Coordinate System, Transformation Matrix. Shape Function of 2D Element.	08	CO5

Reference Books:

Krishnamurthy , Finite Element Analysis.

Budvanan, G.R. Finite Element Analysis.

Zienkiewicz, O Finite Element Method its Basic & Fundamentals

e-Learning Source:

<https://nptel.ac.in/courses/105105041/>

<https://nptel.ac.in/courses/111107062/>

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	0	2	1
CO2	3	3	0	3	0	0	0	0	0	0	0	0	2	1
CO3	3	3	0	3	0	0	0	0	0	0	0	0	2	1
CO4	3	3	0	3	0	0	0	0	0	0	0	3	3	1
CO5	3	3	0	3	0	0	0	0	0	0	0	3	3	1

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE512	Title of the Course	Advanced Steel Structures	L	T	P	C
Year	I	Semester	II	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To impart behavior and design procedures of tension members, compression members and connections. To impart behavior and design procedures of flexural member. To impart requirements and concepts involves in analysis and design of steel chimneys & towers To study the behavior and design requirements of Industrial building. To impart the concept and application of plastic analysis in steel structures 						

Course Outcomes	
CO1	Learner should be able to understand the types and design requirement of tension and compression steel members, then they should be able to design them with connections for given conditions by following the guidelines of Indian codes.
CO2	Learner should be able to understand the behavior of steel flexure member, then able to analysis and design them with connections for given conditions by following the guidelines of Indian codes
CO3	Learner should know the structural behavior of tower and chimney, then should be able to design self supported steel chimney and tower as Indian code provisions
CO4	Learner should be able to understand the requirement and behavior of Industrial building and also able to design elements of industrial building for given conditions by following guide line of Indian codes.
CO5	Learner should be able to apply concept of plastic analysis to analysed steel structures for given conditions

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Design of Steel Structural Element	Connections, Design of compression and tension members.	08	CO1
2	Flexural Member	Design of rolled section beams and plate girder.	08	CO2
3	Tower & Chimney	Analysis and design of steel towers. Design of self-supporting chimney.	08	CO3
4	Industrial Building	Analysis and design of industrial buildings and bents – Design of bracings – Design of crane and gantry girder	08	CO4
5	Plates Analysis & Design	Plastic design of beams, shape factors, moment distribution. Plastic analysis of fixed and continuous beams, propped cantilevers, single bay and two bay portal frames.	08	CO5

Reference Books:

Sarvar Alam Raaz–Design of Steel Structures.

Kazmi and Jindal–Design of Steel Structures.

Limit State Design of Steel Structures by S. K. Duggal, Tata Mc-Graw-Hill Publishing Company.

IS-800-2007 And IS-800-1984

e-Learning Source:

<https://nptel.ac.in/courses/105105162/>

<https://nptel.ac.in/courses/105106113/18>

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	3	0	0	0	0	3	0	1	0	2	1	3
CO2	3	3	3	0	0	0	0	3	0	1	0	2	1	3
CO3	3	3	3	0	0	0	0	3	0	1	0	2	1	3
CO4	3	3	3	0	0	0	0	3	0	1	0	2	1	3
CO5	3	3	3	0	0	0	0	3	0	1	0	2	1	3

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	CE552	Title of the Course	Research Methodology	L	T	P	C
Year	I	Semester	II	3	1	0	4
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	To develop critical thinking and understand the concept of gap identification for research. To identify appropriate research methods for a specific research problem and prepare professional research report						

Course Outcomes	
CO1	Develop the student's understanding of research methods and applying those methodology to solve complex research problems.
CO2	Develop student's understanding of sampling techniques for research.
CO3	Develop student's understanding of different data collection methods and their suitability.
CO4	Students will gain understanding of analyzing the quantitative data.
CO5	Students will gain understanding of analyzing the qualitative data and will learn how to write a professional research report.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Research and Problem Definition	Meaning, Objective and importance of research, Types of research, research process, Challenges in research, Philosophical worldviews in research.	8	CO1
2	Research Design	Research design, Methods of research design, Selection of a Research Design research process and steps involved, Literature Survey, Bibliometric analysis.	8	CO2
3	Data Collection	Sample Design, Sampling Methods, sampling errors, Classification of Data, Measurement and Scaling, Methods of Data Collection, data preparation.	8	CO3
4	Data Analysis and interpretation	Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results.	8	CO4
5	Technical Writing and Reporting of Research	Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Mechanics of writing a report, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism, Oral Presentation.	8	CO5

Reference Books:

C. R. Kothari, Gaurav Garg, Research Methodology : Methods And Techniques, New Age International Publishers; Fourth edition (1 September 2019)

Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc22_ge08/preview

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	1	0	0	0	0	0	0	0	0	0	0	0
CO2	3	3	2	0	0	0	0	0	0	0	0	0	0	0
CO3	3	3	2	3	0	0	0	0	0	0	0	0	0	0
CO4	3	3	2	3	3	0	0	0	0	0	0	0	0	0
CO5	3	3	0	0	0	0	0	3	0	3	0	0	0	0

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	CE514	Title of the Course	Seminar	L	T	P	C
Year	I	Semester	II	0	0	3	2
Pre-Requisite	NIL	Co-requisite	NIL				
Course Objectives	<ul style="list-style-type: none"> To understand organization of topic for presentation and research. To learn the skill set required to perform research. 						

Course Outcomes	
CO1	Skill to search on any topic to extract the inference.
CO2	Ability to organize – deliver presentation and report on any topic.

Unit No.	Content of Unit	Contact Hrs.	Mapped CO
1	Seminar shall be delivered preferably on the topic of dissertation or at least the area of dissertation. The concepts must be clearly understood and presented by the student. Prior to presentation, he/she shall carry out the detailed literature survey from Standard References such as International Journals and Periodicals, recently published reference Books etc. All modern methods of presentation should be used by the student. A hard copy of the report (25 to 30 pages) should be submitted to the Department before delivering the seminar. A PDF copy of the report in soft form must be submitted to the supervisor along with other details if any. Supervisor should guide concern student 2hrs /week/student for seminar.	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	1	2	1	3	3	0	3	3	3
CO2	0	0	0	0	3	1	2	1	3	3	0	3	3	3

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

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------