School of Engineering & Technology (Civil Engineering)
Course Structure & Syllabus for M.Tech. in Civil Engineering
(Structural Engineering)Batch: 2021-23

DIT UNIVERSITY
Dehradun

Detailed Course Structure& Syllabus
of
M.TECH. IN CIVIL ENGINEERING
(STRUCTURAL ENGINEERING)
BATCH 2021–23

Approved by the Academic Council at its 17th Meeting held on 24.03.2021

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Course Structure

Year 1 Semester I

Course Category	Course Code	Course Title	L	T	P	Credit
UC	MA601	Advanced Mathematics	4	0	0	4
DC	CE608	Advanced Structural Analysis	4	0	0	4
DC	CE609	Theory of Elasticity and Plasticity	4	0	0	4
DC	CE601	Advanced Concrete Technology	4	0	0	4
DC	CE604	Advanced Concrete Laboratory	0	0	2	1
DC	CE610	Advanced Steel Design	4	0	0	4
		Total				**21**

Year 1 Semester II

Course Category	Course Code	Course Title	L	T	P	Credit
DC	CE611	Structural Dynamics	4	0	0	4
DC	CE612	Seismic Design of Structures	4	0	0	4
DC	CE605	Finite Element Analysis	4	0	0	4
DE		Elective – I	4	0	0	4
DC	CE613	Computer Aided Design of Structures	0	0	2	1
DC	CE614	Stability of Structures	4	0	0	4
		Total				**21**

Year 2 Semester III

Course Category	Course Code	Course Title	L	T	P	Credit
DE		Elective – II	4	0	0	4
DE		Elective - III	4	0	0	4
DC	CE704	Research Methodology and IPR	2	0	0	2
DC	CE705	Dissertation Phase-I	0	0	12	6
		Total				**16**

Year 2 Semester IV

Course Category	Course Code	Course Title	L	T	P	Credit
DC	CE706	Dissertation Phase-II	0	0	24	12
		Total				**12**

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Elective Basket

Elective -I

S.N.	Course Code	Course Title
1	CE651	Structural Health Monitoring
2	CE652	Theory of Plates and Shells
3	CE653	Advanced Prestressed Concrete
4	CE654	Advanced Foundation Design
5	CE655	Optimization in Structural Design
6	CE656	Advanced Mechanics of Composite Materials

Elective -II

S.N.	Course Code	Course Title
1	CE751	Sustainable Materials and Green Buildings
2	CE752	Soil Structure Interaction
3	CE753	Advanced Reinforced Concrete Design
4	CE754	Design of Masonry Structures
5	CE755	Applied Fracture Mechanics
6	CE756	Maintenance and Rehabilitation of Structures

Elective -III

S.N.	Course Code	Course Title
1	CE761	Design of Advanced Bridges
2	CE762	Design of Industrial Structures
3	CE763	Introduction to Modelling and Simulation
4	CE764	Nonlinear Structural Analysis
5	CE765	Design of Tall Structures
6	CE761	Design of Advanced Bridges

Credit Summary

Year	Semester	Credit	Year Credit
First Year	I	21	42
	II	21	
Second Year	III	16	28
	IV	12	
Total			**70**

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Course Code	CE608	Course Title	Advanced Structural Analysis					
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1	Semester	I

Course Outcome

At the end of the course, the student will be able to

CO1 Understand the concepts of flexibility and stiffness.

CO2 Analyse statically indeterminate plane structures by flexibility matrix method.

CO3 Calculate the unknown displacements and rotations for various types of plane structures by plane structures.

CO4 Evaluate the forces in the members of pinned jointed space truss by stiffness matrix method and flexibility matrix method.

CO5 Determine the unknown displacements for grid and building frame by stiffness matrix method.

Detailed Syllabus:

UNIT-I **(12 hrs)**

Introduction, Types of loads, Compatibility Conditions, Static and Kinematic indeterminacy, Principle of Superposition, Stiffness and flexibility matrix in single, two and n-co-ordinates, Structures with constrained measurements, Energy Concepts & Transformation of Coordinates and its Application.

NIT-II **(10 hrs)**

Flexibility matrix method applied to statically determinate and indeterminate structures- Choice of redundant, Application to various types of structures, Internal forces due to thermal expansion and lack of fit

UNIT-III **(10 hrs)**

Stiffness matrix method- Basis of stiffness method, force-displacement relationships, Nodal Stiffness, Application to various types of structures, Internal forces due to thermal expansion and lack of fit.

UNIT-IV **(10 hrs)**

Space Truss – Analysis of ***pinned jointed*** space truss by stiffness matrix method and flexibility matrix method.

UNIT-V **(10 hrs)**

Space frame – Analysis of ***rigid jointed*** grid and building frame by stiffness matrix method.

Text Books:

1. Mosche, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New York, 1966.
2. Kanchi, Matrix Structural Analysis, Wiley Eastern Ltd., New Delhi, 1981.

References:

1. Pandit G.S. & Gupta, S.P. (2001), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.
2. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001.
3. Analysis of Structures: D. J. Dawe.
4. Matrix Method of Structural Analysis: C.K. Wang.

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Course Code	CE612	Course Title	Seismic Design of Structures						
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1	Semester	II

Prerequisite: Student should have attended course on concrete and steel structures.
Course Objective: The objective of the course is to provide basics of earthquake resistant design of structures.

Course Outcome:
At the end of the course, the student will be able to
CO1 Evaluate seismic forces for various structures as per relevant Indian standards
CO2 Design and draw detailing of structures for seismic resistance as per Indian standards
CO3 Apply concepts of repair and rehabilitation of earthquake affected structures
CO4 Understand the concept of ductility Provision in R.C Buildings
CO5 Design steel and timber structures

Detailed Syllabus:

UNIT-I **(10hrs)**

Earthquakes and Ground Motion: Causes and Consequences of Earthquakes, Seismic Waves, Measurement of Ground Motion, Seismic Zoning. Introduction to Dynamics of Structures and Seismic Response: Modelling of Structures, Equation of Motion, Dynamic/Seismic Response of SDOF Structures, Systems with Multi-Degree of Freedom Systems, Periods and Modes of MDOF Systems; Elastic, Inelastic and Design Spectra, Damping.

UNIT-II **(12hrs)**

Earthquake Resistant Planning and Design of Buildings: Functional Planning: Simplicity and Symmetry, Stiffness and Strength, Twisting of Building, Ductility Provisions, Framing Systems, Introduction to IS Codes, Philosophy of Design: Seismic Co-efficient Method, Response Spectrum Method, Introduction to Time- History Method.

UNIT-III **(8hrs)**

Seismic Isolators. Seismic Design of Masonry Buildings: Box Action and Provision of Bands, Restoration and Strengthening Methods. Seismic Design of RC Buildings: Soft and Weak Storeys, Vertical and Horizontal Irregularities, Reinforcement Detailing Requirements.

UNIT-IV **(6hrs)**

Ductility Provision in R.C Buildings, Confining Reinforcements, Design Example, Frame Members Subjected to Bending and Axial Loads.

UNIT-V **(8hrs)**

Design of steel and timber structures. Design considerations for building appurtenance

Text Books:

1. Elements of Earthquake Engineering: Jai Krishna, A.R. Chandrashekaran, Brajesh Chandra, South Asian Publishers Pvt. Ltd., New Delhi
2. Earthquake Resistant Design of Structures: S.K.Dugal, Oxford University Press, New Delhi

References:

1. Earthquake Resistant Design of Structures, P.Agarwal and M. Shrikhande, Prentice Hall, New Delhi.
2. Dynamics of Structures: A.K. Chopra, Prentice hall, Englewood cliffs, New Jersey.
3. Limit State Design of Steel Structures, S K Duggal, Tata Mc Graw Hill, New Delhi.
4. ***S. L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall International Series in Civil Engineering and Engineering Mechanics.***

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Course Code	**CE613**	**Course Title**	Computer Aided Design of Structures					
LTP	**0 0 2**	**Credit**	**1**	**Subject Category**	**DC**	**Year**	**1**	**Semester**	**II**

Course Outcome
At the end of the course, the student will be able to
CO1 Design all structural components of framed buildings.
CO2 Draw reinforcement detailing.

List of Experiments/Assignments:
STAAD Pro, ETABS, SAP2000 softwares will be used for the following problems:

1. Analysis and Design of (G+3) residential apartments, reinforcement detailing.
2. Analysis and Design of (G+12) shopping complex, reinforcement detailing.

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Course Code	CE651	Course Title	Stability of Structures						
LTP	4 0 0	Credit	4	Subject Category	*DC*	Year	1	Semester	I

Prerequisite: Student should have attended course in structural analysis.
Course Objective: The objective of the course is to provide basics involved in stability of structures.

Course Outcome:
At the end of the course, the student will be able to
CO1 Understand Criteria for Design of Structures
CO2 Understand concept behind Stability of columns and beams
CO3 Perform Mathematical Treatment of Stability Problems
CO4 Understand Torsional Buckling
CO5 Understand Lateral Buckling of Simply Supported Beams

Detailed Syllabus:

UNIT-I **(12 hrs)**

Criteria for Design of Structures: Stability, Strength and Stiffness, Classical concept of stability of discrete and continuous Systems. Linear and non-linear behaviour. Beam Columns: Differential equation for beam columns - Beam column with concentrated loads - Continuous lateral load - Couples - Beam column with built in ends - Continuous beams with axial load.

UNIT-II **(12 hrs)**

Stability of columns and beams: Elastic Buckling of Bars: Elastic buckling of straight columns - Effect of shear stress on buckling - Eccentrically and laterally loaded columns - Energy methods - Buckling of a bar on elastic foundation-Buckling of bar with intermediate compressive forces and distributed axial loads-Buckling of bars with change in cross section-Effect of shear force on critical load-Built up columns. Inelastic Buckling: Buckling of straight bars-Double modulus theory-Tangent modulus theory.

UNIT-III **(6 hrs)**

Mathematical Treatment of Stability Problems: Buckling problem - Orthogonality relation-Ritz method-Timoshenko method and Galerkin method

UNIT-IV **(8 hrs)**

Torsional Buckling: Pure torsion of thin walled bar of open cross section - Non-uniform torsion of thin walled bars of open cross section- buckling by Torsion and Flexure.

UNIT-V **(8 hrs)**

Lateral Buckling of Simply Supported Beams: Beams of rectangular cross section subjected to pure bending. Buckling of Simply Supported Rectangular Plates: Derivation of equation of plate subjected to constant compression in two directions and one direction, finite element method.

Text Books:

1. Stephen P. Timoshenko and James M. Gere., ― Theory of Elastic Stability, McGraw Hill Book company.

References:

1. Blunch- ―Stability of Metallic Structure, Mc Graw Hill.
2. Chem. &Atsute ―Theory of Beam Columns, Vol I Mc Graw Hill.
3. Smitses, ― Elastic Stability of Structures‖, Prentice Hall.
4. Brush and Almorth, ―Buckling of Bars, Plates and Shells , Mc Graw Hill book company.
5. Chajes,A., ― Principles of Structural Stability Theory, Prentice Hall.
6. Ashwini Kumar, ― Stability theory of Structures , Tata Mc Graw Hill Publishing company Ltd, New Delhi.
7. Bleaigh― Elastic Stability, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.

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Course Code	CE655	Course Title	Advanced Foundation Design						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1	Semester	II

Course Objectives: To understand the concepts of bearing capacity of soil so as to have deeper understanding in the design of foundations

Course Outcomes:
At the end of the course, the student will be able to
CO1 Understand the concept of evaluation of bearing capacity for shallow foundations
CO2 Evaluate the load carrying capacity of pile and well foundations
CO3 Perform geotechnical analysis of machine foundations
CO4 Understand the concept of liquefaction of soils
CO5 Understand Geotechnical aspects in Earthquake Engineering

Detailed Syllabus:

UNIT-I **(08 hrs)**

Shallow foundations: Terzaghi's bearing capacity equation, General bearing capacity equation, Meyerhof's Vesic theory, Effect of water table, Special footing problems, I.S. Codes, Footing pressure for settlement on sand, Soil pressure at a depth, Boussineq's & Westergaard's methods, Computation of settlements, Inclined and Eccentric Loads.

UNIT-II **(10 hrs)**

Pile foundations: Timber, Concrete, Steel piles, Estimating pile capacity by dynamic formula, by wave equation and by static methods, Point bearing piles, Pile load tests, Negative skin friction, Modulus of sub-grade reaction for laterally loaded piles, Lateral resistance, Pile group considerations, Efficiency, Stresses on underlying strata, Settlement of pile groups, Pile caps, Batter piles, Approximate and Exact analysis of pile groups, I.S. Codes.

UNIT-III **(8 hrs)**

Well Foundations: Types (open end, closed or box, Pneumatic, Drilled), Shapes, Bearing capacity and settlements, Determination of grip length by dimensional analysis, Stability of well foundations by IRC Method, Construction, Tilts & shifts.

UNIT-IV **(6 hrs)**

Machine Foundations: Types, Analysis and design by Barkans method, Determination of coefficient of uniform elastic compression, and Design of a machine foundation, I.S. Method of design.

UNIT-V **(8 hrs)**

Introduction to Geotechnical Earthquake Engineering: Ground Shaking, Liquefaction, Evaluation, Mechanism, Effects of liquefaction. 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.

Text Books:

1. Bowles, Joseph E. , Foundation Analysis and Design, Tata McGraw Hill (2001).
2. Coduto, Donald P., Foundation Design: Principles and Practice, Prentice Hall (2001).
3. Dass, B. M. , Principles of Foundation Engineering, Thomson Learning (2006).

References:

1. Kramer, Steven L., Geotechnical Earthquake Engineering, Pearson Education (2003).
2. Murthy, V.N.S., Advanced Foundation Engineering, C.B.S. Publishers (2007).
3. ***S. L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall International Series in Civil Engineering and Engineering Mechanics.***

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Course Code	CE664	Course Title	Design of Advanced Bridges						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1	Semester	II

Prerequisite: Student should have attended course on concrete structures at UG level.

Course Objective: The objective of the course is to provide basics in design of bridge structures.

Course Outcome:

At the end of this course, the students will be able to

CO1 Discuss the IRC standard live loads and design the deck slab type bridges.

CO2 Analyse the box culverts for the given loading and detail the box culverts.

CO3 Design T-Beam bridges.

CO4 Understand the stability of piers and abutments.

CO5 Explain the construction of construction joints

Detailed syllabus:

Unit-I **(8 Hrs)**

Introduction, historical review, engineering and aesthetic requirements in bridge design. Introduction to bridge codes. Economic evaluation of a bridge project. Site investigation and planning, Scour - factors affecting and evaluation.

Unit-II **(12 Hrs)**

Bridge foundations - open, pile, well and caisson. Piers, abutments and approach structures; Superstructure - analysis and design of right, skew and curved slabs. Girder bridges - types, load distribution, design. Orthotropic plate analysis of bridge decks.

Unit-III **(10 Hrs)**

Introduction to long span bridges - cantilever, arch, cable stayed and suspension bridges. Methods of construction of R. C. Bridges,

Unit-IV **(8 Hrs)**

Planning and design of flyovers bridges.

Unit-V **(12 Hrs)**

Prestressed concrete bridges and steel bridges Fabrication, Launching & creation. Design and construction of construction joints.

Text Books:

1. D. J. Victor, Essentials of Bridge Engineering, Oxford IBH, 1980.
2. V. K. Raina, Concrete Bridge Practice Analysis Design and Economics, Tata McGraw Hill, 2nd Ed, 1994.
3. ***Indian Standard Codes: IRC:5, IRC:6, IRC:21, SP:16***

References:

1. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, 2006.
2. W. F. Chen and L. Duan, Bridge Engineering Handbook, CRC press, 2003.
3. B. Bakht and L.G. Jaeger, Bridge Analysis Simplified, McGraw Hill, 1987.
4. E. J. O'Brien, and D. L. Keogh, Bridge Deck Analysis, Taylor and Francis, 1999.
5. H. Eggert and W. Kauschke, Structural Bearings, Ernst &Sohn, 2002.
6. T. Y. Lin and N. H. Burns, Design of Prestressed Concrete Structures, John Wiley and Sons, 1981.

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Course Code	**CE754**	**Course Title**	Advanced Steel Design						
LTP	**4 0 0**	**Credit**	**4**	**Subject Category**	***DC***	**Year**	**2**	**Semester**	**III**

Perquisites: Student should have attended course in steel structures at undergraduate level.

Course Objectives: To introduce method for design of steel structures with loading standards as per code provisions

Course Outcomes:
At the completion of this course, the student will be able to
CO1 Design plate girders.
CO2 Design various types of steel structures.
CO3 Design gantry girder.
CO4 Design a single-track railway bridge with lattice girders having parallel chords
CO5 Design steel chimney

Detailed Syllabus:

Unit I **(8 Hrs)**
Elements of a plate girder, design of a plate girder, curtailment of flanges, various type of stiffeners

Unit II **(10 Hrs)**
Design of steel foot bridge with parallel booms and carrying wooden decking, using welded joints.

Unit III **(12 Hrs)**
Complete design of an industrial shed including: i) Gantry girder ii) Column bracket iii) Mill bent with constant moment of inertia iv) Lateral and longitudinal bracing for column bent

Unit IV **(12 Hrs)**
Design of single-track railway bridge with lattice girders having parallel chords (for B.G.) i) Stringer ii) Cross girder iii) Main girders with welded joints iv) Portal sway bracings v) Bearing rocker and rollers.

Unit V **(6 Hrs)**
Introduction to design of various industrial steel structure, Design of steel chimney.

Text Books:
1. Limit state design of steel structures: S K Duggal
2. Design of steel structures: N Subramanian
3. ***Indian Standard Codes: IS: 800***

References:
1. Design of steel structures (Vol. 2): Ram Chandra
2. Design of steel structures: L S Negi
3. Design of steel structures (by limit state method as per IS: 800-2007): S S Bhavikatti