Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

DIT UNIVERSITY
Dehradun

Detailed Course Structure& Syllabus
of
M.TECH. IN CIVIL ENGINEERING
(STRUCTURAL ENGINEERING)
BATCH 2018–20

Amended by the BoS and approved by the Academic Council at its 9th Meeting held on 14.04.2018

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Course Structure

Year: 1 Semester: I

Course Category	Course Code	Course Title	L	T	P	Credit
DC	MA601	Advanced Mathematics	4	0	0	4
DC	CE601	Advanced Concrete Technology	4	0	0	4
DC	CE602	Pre Stressed Concrete	4	0	0	4
DC	CE603	Matrix Method of Structural Analysis	4	0	0	4
DC	CE604	Advanced Concrete Laboratory	0	0	2	1
		Total				**17**

Year: 1 Semester: II

Course Category	Course Code	Course Title	L	T	P	Credit
DC	CE605	Finite Element Analysis	4	0	0	4
DC	CE606	Advanced Reinforced Concrete Design	4	0	0	4
DE		Elective – I	4	0	0	4
DE		Elective -II	4	0	0	4
DC	CE607	Dissertation Phase-I	0	0	4	4
		Total				**20**

List of Electives – (Semester – II)

Sl. No.	Course Code	Course Title
1	CE641	Solid Mechanics
2	CE642	Foundation Engineering
3	CE643	Soil Structure Interaction
4	CE644	Design of Steel and composite structures
5	CE645	Seismic Design of Structures
6	CE646	Ground Improvement Techniques
7	CE647	Structural Dynamics

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Year: 2 Semester: III

Course Category	Course Code	Course Title	L	T	P	Credit
DE		Elective – III	4	0	0	4
DE		Elective - IV	4	0	0	4
DC	CE701	Seminar	0	0	2	4
DC	CE702	Dissertation Phase-II	0	0	16	8
		Total				**20**

List of Electives – (Semester – III)

Sl. No.	Course Code	Course Title
1	CE741	Construction Techniques and Management
2	CE742	Bridge Engineering
3	CE743	Design of Tall Buildings
4	CE744	Theory of Plates and Shells
5	CE745	Maintenance and Rehabilitation of Structures
6	CE746	Optimization in Structural Design
7	CE747	Hydraulic Structures
8	CE748	Dynamics of Earth and Environment

Year: 2 Semester: IV

Course Category	Course Code	Course Title	L	T	P	Credit
	CE703	Dissertation Phase-III	0	0	32	16
		Total				**16**

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Summary of the Credits

Year	Semester	Credit	Year Credit
First Year	I	17	37
	II	20	
Second Year	III	20	36
	IV	16	
Total			73

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	MA601	Subject Title	Advanced Mathematics						
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1st	Semester	I

UNIT-I

Numerical Techniques

Zeros of Transcendental and Polynomial equation using bisection method, Newton-Raphson method, Rate of convergence of above methods. Interpolation: Finite differences, difference tables, Newton's Forward and Newton's Backward Interpolation, Lagrange's and Newton divided difference formula for unequal intervals. Solution of system of Linear equations, Gauss-Seidal method, Crout method. Numerical Integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Solution of ordinary differential (first order, second order and simultaneous) equations by Picard's and Fourth order Runga - Kutta methods

UNIT-II

Partial Differential Equations (PDE)

Formation and Classification of PDE, Solution of One Dimension Wave Equation, and Heat Equation, Two Dimension Heat and Laplace Equation by Separation of variables Method.

UNIT-III

Special Functions

Series solution of ODE of 2nd order with variable coefficient with special emphasis to Legendre and Bessel differential equation, Legendre polynomial of first kind, Bessel Function of first kind and their properties.

UNIT-IV

Statistics:

Elements of statistics, frequency distribution: concept of mean , median, mode, Standard derivation , variance and different types of distribution: Binomial, Poisson and Normal distribution, curve fitting by least square method, Correlation and Regression, Concept of Hypothesis Testing.

UNIT-V

Optimization:

Formulation, Graphical method, Simplex method, Two-Phase simplex method, Duality, Primal-dual relationship, Dual-simplex method.

Text Books:

- R. K. Jain & S. R. K. Iyenger: Advanced Engineering Mathematics, Narosa publication, 2014.
- Jain, Iyenger& Jain: Numerical methods for scientific &Engg. Computation, New age, 2003.
- Gupta S. C., Kapoor V. K.: Fundamentals of Statistics, Sultan Chand & Sons,Eleventh Edition (Reprint) 2014.

Reference Books:

- E. Kreyszig: Advanced Engineering Mathematics, Wiley publication.
- B.S. Grewal: Higher Engineering Mathematics, 42nd Edition, Khanna Publication, India, 2012.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE601	Subject Title	Advanced Concrete Technology						
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1st	Semester	I

Course Objectives: Concrete is the most widely used material in the world. It plays an important role in infrastructure and private buildings construction. This course is designed to impart more comprehensive knowledge on concrete technology, including the introduction of end use guided research strategy for concrete, unification of materials and structures studies, and an emphasize on fundamental exploration of concrete structures, state of art of concrete development, and innovations.

UNIT-I

Aggregates classification, Testing of Aggregates, fibers. Cement, grade of Cement, chemical composition, Hydration of Cement, Structure of hydrated Cement, Special Cement, Water, Chemical and Mineral Admixtures.

UNIT-II

Principles of Concrete mix design, methods of Concrete mix design, Design of high strength and high performance concrete.

UNIT-III

Rheological behavior of fresh Concrete- Properties of fresh and hardened concrete- Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength. Non-destructive testing and quality control, Durability, corrosion protection and fire resistance.

UNIT-IV

Modern trends in concrete manufacture and placement techniques, Methods of transportation, Placing and curing-extreme whether concreting, Special concreting methods, Vacuum dewatering of concrete-Under water concreting.

UNIT-V

Light weight Concrete, Fly-ash Concrete- Fibre reinforced Concrete, Polymer Concrete, Epoxy resins and screeds for rehabilitation- properties and application.

Learning Outcomes: This Course would prove to be very useful for all structural engineering students whether they are heading for design industry or construction industry or even for academics. The course content spans from basic concept of concrete technology to the highly advanced methods involve in concreting practices. The subject not only trains a student for hands on practice for mix design of concrete but it also helps them in understanding the NDT, special concreting methods and rehabilitation methods in concreting.

Text Books:

1. Krishnaraju, N., Advanced Concrete Technology, CBS Publishers, 1985.
2. Nevile, A.M., Concrete Technology, Prentice Hall, Newyork, 1985.
3. A.R. Santhakumar, :Concrete Technology" Oxford University Press, 2006

References:

1. Shetty,M.S. "Concrete Technology", S.Chand& Company, New Delhi,2002.
2. Gambhir, M.L. "Concrete Technology", Tata McGraw Hill New Delhi, 1995.
3. Design of Concrete Mixes by N.Krishna Raju, CBS Publications, 2000.
4. Concrete: Micro Structure by P.K.Mehta, ICI, Chennai.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE602	Subject Title	Pre Stressed Concrete						
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1st	Semester	I

Course Objective: To perform analysis and design of pre-stressed concrete members and connections and to become familiar with professional and contemporary issues in design and fabrication of pre-stressed concrete members.

UNIT-I

Materials, Basic Principles of Pre-Stressing, Pre-stressing Systems: Basic concepts of pre-stressing, High strength concrete and steel, Stress-strain characteristics and properties, Various pre-stressing systems, Pre-tensioning and Post- tensioning systems with anchorages, Advantages and limitations of pre-stressed concrete.

UNIT-II

Analysis of Sections for Flexure: Basic assumptions, Analysis of stresses in concrete due to pre- stress and loads for different types of cross section, Pressure line or thrust line, Cable profile, Concept of load balancing, Cracking moment.

UNIT-III

Losses of Pre-Stress & Deflections: Nature of losses in pre-stress, Various losses encountered in pre-tensioning and post tensioning methods, Deflection, Factors influencing deflection, Elastic deflection under transfer loads and due to different cable profile. Deflections limits as per IS-1343. Effects of creep on deflection, crack widths.

UNIT-IV

Flexural and Shear Strength of Pre-stressed Concrete Sections: Types of flexural failure, IS code recommendations for flexure, Ultimate flexural strength of section. Shear and principal stresses, Ultimate shear resistance of pre-stressed concrete members, Shear reinforcement. Design of beams for flexure and shear as per IS code provisions.

UNIT-V

Transfer of Pre-stress in Pre tensioned Members and Anchorage Zone Stresses in Post Tensioned Members: Transmission of pre-stress in pre-tensioned members, Transmission length, Bond stresses, Codal provisions for bond and transmission length, Anchorage stress in post- tensioned member. Bearing stress and bursting tensile force, IS code provisions.

Learning Outcomes: Students will understand the general mechanical behavior of pre-stressed concrete, to analyze and design pre-stressed concrete flexural members.

Text Books:

1. Raju, N. K., “Pre-stressed concrete”, Tata McGraw Hill, New Delhi, 1st Edition, 2012.
2. Ramamruthum, S., “Pre-stressed Concrete”, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2003.
3. Lin, T. Y., Burns, N. H., “Design of pre- stressed Concrete Structures”, John Wiley and Sons. New York, 3rd Edition, 1981.

References:

1. Leonhardt.F. "Prestressed Concrete Design and Construction", Edition Wilhelm Ernst &Sohn, Berlin, 1964
2. Guyon .V. "Limit State Design of Prestressed Concrete", Applied Science Publishers, London 1995
3. Dayaratnam.P., "Prestressed Concrete", Tata McGraw Hill Publishing Co. New Delhi 2000.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE603	Subject Title	Matrix Method of Structural Analysis						
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1st	Semester	I

Course Objectives: It is the prime responsibility of the structural engineer to ensure that the structures transmit the service loads safely and efficiently. In order to discharge this responsibility effectively, a clear understanding of structural response is essential. The objective of this course is to impart a clear and systematic picture of the forces and their effects on structural systems using Matrix Method of Structural Analysis.

Unit –I

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 – Betti's Law and its Application.

Unit-II

Flexibility 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

Stiffness 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

Introduction to Element Approach, Member stiffness matrix, Local or Member co-ordinate system, Global or structural co-ordinate system, Rotation of axes, Structure Stiffness matrix, Computer oriented stiffness method.

Unit-V

Analysis by substructure using the stiffness method and flexibility method with tri-diagonalization, Analysis by Iteration method, frames with prismatic members, non-prismatic members.

Learning Outcomes: This course would train an individual for the analysis of large ad important structures.

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.
3. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001.
4. Analysis of Structures: D. J. Dawe.
5. Matrix Method of Structural Analysis: C.K. Wang.

References:

1. Pandit G.S. & Gupta, S.P. (2001), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE604	Subject Title	Advanced Concrete Laboratory						
LTP	0 0 2	Credit	1	Subject Category	DC	Year	1st	Semester	I

Course objective: To provide hands on training on advanced test methods on fresh and hardened concrete

List of Experiments

1. Tests on Cement –
    a. Specific Gravity of Cement.
    b. Standard Consistency of Cement.
    c. Setting time of Cement.
    d. Soundness of Cement.
    e. Compressive Strength of Cement.
2. Tests on Aggregate –
    a. Bulking of Fine Aggregate.
    b. Specific Gravity of Fine & Coarse Aggregate.
3. IS Method of Mix Design for Normal Concrete.
4. Workability Tests on Fresh Properties of Normal concrete -
    a. Slump Cone Test.
    b. Compaction Factor Test.
    c. Vee-Bee Consistometer Test.
5. Mix Design of Self Compacting Concrete (SCC).
6. Tests on Fresh Properties of SCC
7. Compressive strength of Concrete.
8. Flexure Testing of Beams.
9. Non Destructive Testing of Concrete

Learning outcome: Students will be trained in various experiments as per the relevant IS codes of practices.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE605	Subject Title	Finite Element Analysis						
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1st	Semester	II

Course Objectives: This course is designed to impart basic as well as comprehensive skills of structural analysis based on finite element method. To enable students to formulate the design problems into FEA.

UNIT I

Introduction, General description of method, FEM vs Classical method, need for studying FEM, Basic equation of elasticity, Equation of equilibrium, strain displacement equations, Linear constitutive laws

UNIT II

Finite element analysis of bar and trusses, Matrix displacement equations, Solution of Matrix displacement equations

UNIT III

Element- 1,2,3 dimensional, shapes- triangular, rectangular, tetrahedral, nodes, nodal unknowns and coordinate systems- global, local and natural, Discretization of structure, refining mesh, higher order element vs mesh refinement.

UNIT IV

Shape functions, polynomial shape functions, finding shape functions using polynomials and Lagrange polynomials

UNIT V

Finite element analysis of plane stress and plane strain problems, Isoparamatric formulation, Non-plinear analysis.

Learning Outcomes: Students will be able to identify mathematical models for the solution of common Engineering problems, formulate simple problems into finite elements, derive element matrix equations by different methods.

Text Books:

Finite Element analysis: S.S. Bhavikatti, New Age International Publishers

Introduction to Finite Elements in Engineering: T.R. Chandrupatla and A.D. Belegundu, Prentice Hall Publishers

Reference books:

Finite Element Structural Analysis: T.Y.Yang

Concepts and applications of Finite Element Analysis: Robert D. Cook.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE606	Subject Title	Advanced Reinforced Concrete Design						
LTP	4 0 0	Credit	4	Subject Category	DC	Year	1st	Semester	II

Course Objectives: The primary objective of the course is to extend students' knowledge and proficiency in reinforced concrete structural design, analysis and special detailing

UNIT-I

Basic Design concepts: Review of limit state design of beams, Behavior in flexure, Design of singly Reinforced rectangular sections, Design of Doubly Reinforced rectangular sections; Design of flanged beam sections, Design for shear.

UNIT-II

Design of Reinforced Concrete Deep Beams: Steps of Designing Deep Beams, Design by IS 456, Checking for Local Failures, Detailing of Deep Beams.

UNIT-III

Slabs: Design of circular & flat slabs, Yield line analysis of slabs

UNIT - IV

Design of special RC elements: Design of slender columns, corbels & Edge (spandrel) Beams.

UNIT - V

Shear wall: Design and analysis of shear walls for framed buildings.

Learning Outcomes: Students will be able to develop structural member modeling and analyze structural members by developing small computer programs

Text Books:

1. Reinforced concrete design by s. unnikrishna Pillai & Menon, TMH.
2. Advanced Reinforced Concrete Design - PC Varghese Practice Hall 2008
3. Limit state theory and design of reinforced concrete by Dr. S.R. Karve and Dr V L Shah, Standard publishers, Pune, 3rd Edition 1994
4. Advanced concrete design, by N. Krishna raju, CBS Publishers and distributors, delhi.

References:

1 .Reinforced concrete design by KennathLeet, TMH.
2. Reinforced concrete structural elements - behaviour, Analysis and design by P' Purushotham' Tata Mc.Graw-Hill, 1994.
3. Design of concrete structures -Arthus H. Nilson, David Darwin, and chorles w' Dolar, Tata Mc' Graw-Hill, 3'd Edition, 2005.
4. Reinforced concrete structures, Vol.l, byB.c.Punmia, AshokKumar Jain and Arun Kumar Jain, Laxmi Publications, 2004.
5. Reinforced concrete structures - l.C' Syal& A'K Goel' S' Chand' 2004'.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE641	Subject Title	Solid Mechanics						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1st	Semester	II

Course Objective: To solve advanced solid mechanics problems using classical methods and to apply commercial softwares on selected applied soild mechanics problems

Unit 1

Analysis of Stress and Strain: Analysis of stress and strain, stress-strain relationship. Generalized Hook's law.Plane stress and plain strain.

Unit 2

2D Problems: two dimensional problems in Cartesian and polar co-ordinates for simple problems.

Unit 3

Torsion: Torsion of non-circular sections: methods of analysis- membrane analogy- torsion of thin rectangular and hollow thin walled sections.

Unit 4

Energy methods: Energy methods: Principles of virtual work- energy theorm- Rayleigh-Ritz method- Finite difference method.

Unit 5

Introduction to problem in Plasticity: Physical assumptions – criterion of yielding, yield surface, Flow rule (Plastic stress and strain relationship). Elastic plastic problems of beams in bending – plastic torsion.

Learning Outcomes: To understand the theory of elasticity, to solve for stresses and deflection of beams and to apply various failure criteria.

Text Books:

1. Timoshenko, S. and Goodier T.N., Theory of Elasticity, McGraw–Hill Ltd., Tokyo, 1990.
2. Chenn, W. P and Henry D. J., Theory of Elasticity, D.J., SpringerVerlac, New York, 1988
2. Sadhu Singh, Theory of Elasticity, Khanna Publishers, New Delhi 1988.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE642	Subject Title	Foundation Engineering						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1st	Semester	II

Course Objective: This course is designed to comprehend and utilize geotechnical literatures to establish the framework for foundation design.

Unit 1

Site investigation & exploration, location, depth of bore holes and bore log chart. Penetrometer tests, pressure meter tests, geophysical methods.

Unit 2

Shallow foundations: Introduction, various bearing capacity theories, settlement of shallow foundation. I.S .Code on structural safety of foundations, Allowable total and differential settlements.

Unit 3

Earth pressure at rest, active and passive earth pressures, Earth pressure theories: Rankine, Coulumb, Culmann.

Unit 4

Pile Foundations: Type of Piles, Load test on piles, DynamicFormula, StaticFormula. Group action of piles, clays-settlement and bearing capacity, I.S.Codes of piles.Behaviour of pile under lateral loading-Winkler's assumptions and theoryof beam on elastic foundations.

Unit 5

Sheet piles and Bulk Heads.Under Pinning of Foundations. Well foundation, Tilts and shifts in wells.

Learning Outcomes: To plan and implement site investigation programs including subsurface exploration to evaluate soil behavior and to obtain necessary design parameters.

Text Books:

1. *Gopal Ranjan* and Rao A.S.R., "Basic and applied *soil mechanics*", New Age International (P) Limited, Publishers, New Delhi
2. Bowels, Joseph E.(1996). Practical Foundation Engineering Handbook. 5th edition, McGraw-Hill, New York.
3. Das, Braja M. (1999). Principles of foundation Engineering, 4th edition, PWS publishing, Pacific Grov. Calif.
4. Praksh, Shamsher, and Sharma, Hari D. (1990). Pile foundation in Engineering Practice, John Wiley & Sons, New York.
5. Varghese, P.C. (2005). Foundation Engineering Prentice –Hall of India Pvt. Ltd. New Delhi-001.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE643	Subject Title	Soil Structure Interaction						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1st	Semester	II

Course Objective: The aim of the course is to provide the students an understanding of effectively simulating the soil structure interaction problems using computer application and realistic material models.

UNIT 1

Soil foundation Interaction: Introduction to soil foundation interaction problems, soil behaviour, foundation behaviour, interface behaviour, scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, two parameter elastic model, Elastic Plastic behaviour, Time dependent behaviour.

UNIT 2

Beam on Elastic foundation-soil models:
Infinite beam, two parameters, Isotropic elastic half space, analysis of beams of finite length, classification of finite beams in relation to their stiffness.

UNIT 3

Plate on Elastic medium:
Infinite plate, Winkler, two parameters, isotropic elastic medium, thin and thick plates, analysis of finite plates: rectangular and circular plates, Numerical analysis of finite plates, simple solutions.

UNIT 4

Elastic analysis of piles:
Elastic analysis of single pile, theoretical solutions for settlement and load distributions, analysis of pile group, interaction analysis, load distribution in groups with rigid cap.

UNIT 5

Laterally loaded pile:
Load deflection prediction for laterally loaded piles, sub-grade reaction and elastic analysis, interaction analysis, pile raft system, solution through influence charts.

Learning Outcomes: At the end of the course students are expected to learn basics of finite difference and finite element analysis and realistic material models for structural materials, soils and interface.

Text Books:

1. Elastic analysis of soil foundation interaction By Selvadurai, A.P.S.
2. Pile Foundation Analysis and Design ByPoulos, H.G. & Davis E.H.
3. Foundation Analysis By Scott, R.F.
4. Structure Soil Interaction- State of Art Report, Institution of Structural Engineers, 1978, Geotechnical Earthquake Engineering By Kramer, S.L

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE644	Subject Title	Design of Steel and composite structures						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1st	Semester	II

Course Objective: To understand the fundamentals of designing steel structures and relevant codes of practices

UNIT 1

Design of members subjected to lateral loads and axial loads - Principles of analysis and design of Industrial buildings and bents - Crane gantry girders and crane columns – Analysis and design of steel towers - Design of industrial stacks - Self supporting and guyed stacks lined and unlined.

UNIT 2

Types of connections, Design of framed beam connections, Seated beam connection, Unstiffened, Stiffened Seat connections, Continuous beam – to - beam connections and continuous beam–to–column connection both welded and bolted.

UNIT 3

Cold formed Steel Sections - Types of cross sections - Local buckling and post buckling - Design of compression and Tension members - Beams - Deflection of beams – Combined stresses and connections.

UNIT 4

Introduction to composite design – shear connectors – types of shear connectors – degrees of shear connections – partial and full shear connections – composite sections under positive bending – negative bending – propped conditions – un-propped conditions – deflection of composite beams.

UNIT 5

Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span - Types of Composite columns – design of encased columns – design of in-filled columns – axial, uni-axial and bi-axially loaded columns. Composite shear wall – double skinned composite deck panels – composite trusses – composite frames – composite plate girders.

Learning Outcomes: At the end of the course students will be able to design steel structures.

Text Books:

1. Arya, A.S., Design of Steel Structures, New Chand & Brothers, New Delhi 1982.
2. R.P. Johnson, “Composite Structures of Steel & Concrete”, Blackwell Scientific publications, UK.
3.*Duggal S K*., Design of *Steel* Structures, Tata McGraw-Hill Education

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE645	Subject Title	Seismic Design of Structures						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1st	Semester	II

Course Objective: To understand the fundamentals of designing structures subjected to earthquake loading and the relevant codes of practice.

UNIT I

Engineering Seismology: Earthquake phenomenon cause of earthquakes- Faults – plate seismic tectonics- waves- Magnitude/Intensity – Energy released- Earthquake measuring instruments- Seismic zones in India – Review of damage in past earthquakes.

UNIT II

Conceptual design: Introduction – Twisting of buildings – Ductility – Seismic design requirements – regular and irregular configurations – basic assumptions – design earthquake loads – basic load combinations – seismic methods of analysis – factors in seismic analysis – Equivalent load method – Response spectrum method – Time history method.

UNIT III

Reinforced concrete buildings: Principles of earthquake resistant design of RC members- structural models for frame buildings- seismic methods of analysis - seismic design methods- IS code based methods for seismic design – seismic evaluation and retrofitting – Lateral load resisting systems – Determination of design lateral forces – Lateral distribution of base shear – Base Isolation Techniques

UNIT IV

Masonry Buildings: Introduction – Elastic properties of masonry assemblage – Categories of masonry buildings – Behavior of unreinforced and reinforced masonry walls – Improving seismic behavior of masonry buildings - Seismic design requirements - Lateral load analysis of masonry buildings.

UNIT V

Ductility Consideration of Earthquake resistant design of RC Buildings: Introduction – Impact of ductility- Requirements of ductility- Assessment of ductility – Factors affecting ductility – Ductile detailing considerations as per IS 13920. Behavior of beam, columns and joints in RC buildings during earthquakes – Vulnerability of open ground story and short columns during earthquakes.

Learning Outcomes: Students will be able to design Earthquake resistant structures

Text Books:

1. Earthquake Resistant Design of structures - S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures - Pankaj Agawal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.
3. Seismic Design of Reinforced Concrete and Masonry Building -T Paulay and M.J.N. Priestly, John Wiley & Sons

Reference:

1. Masory and Timber structures including earthquake Resistant Design -Anands.Arya, Nemchand& Bros

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE646	Subject Title	Ground Improvement Techniques						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1st	Semester	II

Course Objective: To understand the fundamentals of different ground improvement methods and its applications to civil Engineering structures.

UNIT 1:

Dewatering and Drainage Mechanism: Introduction- Scope and necessity of Ground improvement in geotechnical engineering, Classification of Ground Improvement Technique; Basic concepts of Drainage-Groundwater and Seepage control, Methods of Dewatering System, Drains.

UNIT 2:

Compaction and Vertical Drain: Introduction, Methods of compaction, Moisture-Density relationship, engineeringbehaviour of compacted fine- grained soils, Compaction control tests, liquefaction of soils and its remedial measures; Compressibility of soil and consolidation; preloading methods, concepts of vertical drains.

UNIT 3:

Grouting and Stabilization: Grouting- types of grout, aspects of grouting, grouting procedure, field equipment, application, requirements of soil stabilization, mechanical stabilization, Portland cement stabilization, bituminous (cementing) stabilization, chemical stabilization, thermal methods of stabilization.

UNIT 4:

Geosynthetics: Introduction, geosynthetic types, properties of geosynthetics, application of geosynthetics.

UNIT 5:

Soil reinforcement: Ground anchors, components of anchor, rock bolt, soil nailing, types of failure of soil nailed walls, stone columns, sand columns, soil-lime columns, Application of soil reinforcement in ground improvement.

Learning Outcomes: Students will be able to appreciate the advantages ground improvement methods from structural Engineering perspective

Text Books

1. Orlando B. A. (1994). “Introduction To Frozen Ground Engineering”, CHAPMAN & HALL, NEW YORK.
2. “Ground Engineering”. The Institute of Civil Engineers, London, 1970
3. Rawlings,C G, Hellawell,E. E. and Kilkenny,W. M.(2000). “Grouting For Ground Engineering “, CIRIA, LONDON

Reference Books

- Koerner, R. M. (1990). “Designing With Geosynthetics”, PRENTICE-HALL.
- Wood, I. R. (1982). “Vertical Drains”, THOMAS TELFORD.
- Davics, M. C. and Schlosser, F. (1997). “Ground Improvement Geosystems”, THOMAS TELFORD, London
- Moseley, M. P. (1993). “Ground Improvement”, BLACKIE ACADEMIC & PROFESSIONAL, LONDON.
- Hausmann, M. R.(1990). “Principles of Ground Modifications”, McGraw-Hill Singapore.
- Som, N & Das, S. P(2003). “Theory and practice of Foundation Design”, Eastern Economy Edition, India.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE647	Subject Title	Structural Dynamics						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	1st	Semester	II

Course Objective: The objective of this course is to develop fundamental concepts of structural behavior under dynamic loading conditions.

UNIT 1

Introduction to Dynamic analysis - Elements of vibratory systems and simple Harmonic Motion- Mathematical models of SDOF systems - Principle of Virtual displacements - Evaluation of damping resonance.

UNIT 2

Fourier series expression for loading - (blast or earthquake) - Duhamel's integral – Numerical methods - Expression for generalised system properties - vibration analysis Rayleigh's method - Rayleigh - Ritz method.

UNIT 3

Evaluation of structural property matrices - Natural vibration - Solution of the Eigen value problem - Iteration due to Holzer and StodolaIdealisation of multi-storeyed frames - analysis to blast loading - Deterministic analysis of earthquake response - lumped SDOF system

UNIT 4

Differential equation of motion - Beam flexure including shear deformation and rotatory inertia - Vibration analysis using finite element method for beams and frames

Learning outcomes: This course will provide clear understanding of single degree and multi degree freedom systems. This will be helpful in the analysis and design of the structures under dynamic loading conditions like seismic load.

Text Books

1. Mario Paz, and William Leigh, Structural Dynamics, CBS, Publishers, 1987.
2. Roy R Craig, Jr., Structural Dynamics, John Wiley & Sons, 1981.
3. A.K. Chpora "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE741	Subject Title	Construction Techniques and Management						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objective: To understand the construction techniques and equipment for effective construction and to explain the fundamentals of quality and safety in construction industry.

UNIT 1

Construction planning-Construction facilities, Schedules, Layout of Plant utilities, Construction methods: Excavation and handling of Earth and Rock; Production and handling of Aggregates and Concrete , cooling of concrete in dams.

UNIT 2

Factors affecting selection of equipment - technical and economic, construction engineering fundamentals, Analysis of production outputs and costs, Characteristics and performances of equipment for Earth moving, Erection, Material transport etc.

UNIT 3

Introduction to quality.Planning and control of quality during design of structures.Quantitative techniques in quality control.Quality assurance during construction.Inspection of materials and machinery.Quality standards/codes in design and construction.Concept and philosophy of total quality management (TQM).Training in quality and quality management systems (ISO-9000).

UNIT 4

Building Maintenance: Scheduled and contingency maintenance planning. Management Information System (MIS) for building maintenance. Maintenance standards.Economic maintenance decisions.

UNIT 5

Concrete Construction methods: form work design and scaffolding, slip form and other moving forms, pumping of concrete and grouting mass concreting (roller compacted concrete), ready mixed concrete, various methods of placing and handling concrete, Accelerated curing, Hot and cold weather concreting, Under water concreting, Pre-stressing.

Learning Outcomes: Students will develop a keen acumen for quality constructions with due regards to safety and economy.

Text Books:

1. Peurifoy, R.L. and Ledbetter, W.B.; Construction Planning, Equipment and Methods, McGraw Hill Singapore, 1986.
2. Robertwade Brown; Practical Foundation Engineering Handbook, McGraw Hill Publications, 1995.
3. Joy, P.K.; Total Project Management- The Indian Context, New Delhi, MacMillan India Ltd., 1992.
4. Uliman, John.E, et al; Handbook of Engineering Management, Wiley, New York , 1986.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE742	Subject Title	Bridge Engineering						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objective: To develop fundamental concepts of analysis and design of bridge structures.

UNIT-I

Introduction: Types of Bridges-Economic span length-Types of loading- Theories of Lateral Load distribution - Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Standard specifications for road and railway bridges -General Design Requirements.

UNIT-II

Solid slab Bridges: Introduction-Method of Analysis and Design.

UNIT-III

Girder Bridges:-Introduction-Method of Analysis and Design- Courbon's Theory Grillage analogy

UNIT-IV

Pre-Stressed Concrete Bridges: Pretensioned and post tensioned concrete bridges; analysis of section for flexure, shear and bond; losses in prestress, deflection of girder; partial prestressing; analysis and design of anchorage block; box girder bridge

UNIT-V

Abutment and piers: scour at abutment and piers; types of foundations; analysis for stresses and design; introduction to soil-structure interaction.

Learning Outcomes: Students will be able to explain the components of Bridges, analyze and designs Bridges.

Texts

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. Design of concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani.

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.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE743	Subject Title	Design of Tall Buildings						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objectives: Objective of this course is to train a post graduate student for analysis and design of tall buildings. The course content deals with the analytical techniques having potential to solve the complex forms of tall buildings. More emphasis is given on the fundamental approaches to the analysis of the behaviour of different forms of tall biding structures including framed system, shear wall system etc.

UNIT I

Introduction - Classification of buildings according to NBC – Types of loads – wind load – Seismic load – Quasi static approach.

UNIT II

Plane Frame System - Calculation of wind load – Approximate method – Portal -Cantilever and factor methods – Kani's method – Substitute frame method for dead load and live loads.

UNIT III

Shear Wall System - Rosman's analysis – Design aspect – RC frame and shear wall interaction – Equivalent frame method.

UNIT IV

In-filled Frame Systems - Importance – Methods of analysis – Equivalent truss and frame method– Force-displacement method – Effect of perforation in the in-filled frame.

UNIT V

Overall buckling analysis of frames: Wall – frames–second order effects of gravity of loading–simultaneous first order and P-delta analysis Translational - torsional instability, out of plum effects

Learning Outcomes: This Course would prove to be very useful for all structural engineering students whether they are heading for design industry or construction industry or even for academics. The course content spans from basic concept of structural analysis to the highly advanced methods involve in analysis of complex structural forms.

Text Book:

1. Bryan Stafford smith and Alex coull, Tall Building Structures – Analysis and Design,
John Wiley & sons, 2006.
2. Ramachandra (2005), Design of Steel Structures–Vol.II, Standard Book House, 1750, NaiSarak, delhi-6.

Reference Books:

1 SarwarAlamRaz, (2001), Analytical methods in Structural Engineering, Wiley Eastern Private Limited, New Delhi.
2. Ghali.A.,Neville.A.M and Brown.T.G, (2003), Structural Analysis – A unified classical and Matrix Approach (Fifth Edition), Span press.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE744	Subject Title	Theory of Plates and Shells						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objective: To study the fundamental behavior of plates and shells and the theories involved therein.

UNIT I

Simple bending of Plates-Assumptions in thin plate theory-Different relationships- Different Boundary Conditions for plates- Plates subjected to lateral loads – Navier's method for simply supported plates – Levy's method for general plates – Example problems with different types of loading.

UNIT II

Circular plates subjected to Axially-symmetrical loads–concentrated load, uniformly distributed load and varying load – Annular circular plate with end moments.

UNIT III

Rayleigh-Ritz method – Application to different problems – Finite difference method – Finite element methodology for plates-Orthotropic Plates Bending of anisotropic plates with emphasis on orthotropic plates – Material Orthotropy – Structural Orthotropy - Plates on elastic foundation.

UNIT IV

Shells- Classification of shells - Membrane and bending theory for singly curved and doubly curved shells - Various approximations - Analysis of folded plates

Learning Outcome: Students will be able to understand the behavior of thin structures.

Text books

1. Rudolph Szilard, Theory and Analysis of Plates, Prentice Hall, New Jercy 1986.
2. Stephen .P. Timoshenko &Woinowsky Krieger, Theory of Plates and Shells, Mc Graw Hill, 1984.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE745	Subject Title	Maintenance and Rehabilitation of Structures						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objective: To develop the skills to understand the techniques of retrofitting of structural Element

UNIT I

Serviceability and Durability of Structures - Quality Assurance for concrete construction - Fresh Concrete properties – Strength – Permeability - Cracking - Effects due to climate – Temperature – chemicals - Wear and erosion - Design and construction errors - Corrosion mechanism - Effects of cover thickness and cracking - Methods of corrosion protection – Inhibitors - Resistant steels – Coatings - Cathodic protection

UNIT II

Diagnosis and Assessment of Distress - Visual inspection – Nondestructive tests – Ultrasonic pulse velocity method – Rebound hammer technique – ASTM classifications – Pullout tests – Core test.

UNIT III

Materials for Repair - Special concretes and mortar - Concrete chemicals – Special elements for accelerated strength gain - Expansive cement - Polymer concrete – Ferro cement, Fibre reinforced concrete - Fibre reinforced plastics.

UNIT IV

Techniques for Repair - Rust eliminators and polymers coatings for rebars during repair - Foamed concrete - Mortar and dry pack - Vacuum concrete - Gunite and shotcrete - Epoxy injection - Mortar repair for cracks - Shoring and underpinning.

UNIT V

Rust eliminators and polymers coating for rebars during foamed concrete, mortar repair for cracks, shoring and underpinning- Repairs to overcome low member strength – Deflection – Cracking -Chemical disruption - Weathering wear - Fire leakage – Marine exposure.

Learning Outcome: At the end of the coursestudents will have in depth knowledge of retrofitting of various structures.

Text books

1. Raikar, R.N., Learning from failures – Deficiencies in Design, Construction and Service – R&D Centre (SDCPL), RaikarBhavan, 1987.
2. Allen R.T., and Edwards S.C, Repairs of Concrete Structures, Blaike and Sons, U.K.1987.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE746	Subject Title	Optimization in Structural Design						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objective: To study the fundamentals of simulation as applicable in Civil Engineering structures.

UNIT-I

Introduction to optimization: Introduction - Historical developments – Engineering applications of optimization - classification of optimization problems - Optimization Techniques. Optimization by calculus - treatment of equality constraints _ Extension to multiple equality constraints - Optimization with inequality constraints - The generalized Newton-Raphson method.

UNIT-II

Linear Programming: Introduction - Applications - standard form of a linear programming- Geometry of linear programming problems - Solution of a system of Linear simultaneous equations - pivotal reduction of a general system of equations - Motivation of the simplex Method - simplex Algorithm

UNIT-III

Non-Linear Programming: Introduction - Unimoial Function - unrestricted search - Exhaustive search - Dichotomous search - Interval Halving method _ Fibonacci method - Golden section method - comparison of elimination methods _ Unconstrained optimization techniques - Direct search methods - Random search methods _ grid search method - Univariate method - Powell's method - simplex method – Indirect search methods - Gradient of a function - steepest descent method - conjugate gradient - Newton's method.

UNIT-IV

Dynamic Programming: Introduction - Multistage decision processes - concept of suboptimization and the principle of optimality - computational procedure in dynamic programming - example illustrating the Calculus method of solution - example illustrating the tabular of solution - conversion of a final value problem into an initial value problem - continuous dynamic programming.

UNIT-V

Network Analysis: introduction - Elementary graph theory - Network variables and problem types - Minimum-cost route - Network capacity problems - Modification of the directional sense of the network -
Application of optimization techniques to Trusses, Beams and Frames.

Learning outcomes: To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.

Text Books:

1. Optimization: Theory and Applications by S.S. Rao.
2. Numerical optimization Techniques for Engineering Design with applications by G.N.Vanderplaats.
3. Introduction to Optimum Design by J.S.Arora

References:

1. Elements of Structural Optimization by R.T.Haftka and Z.curdal.
2. Optimum Structural Design by U.Kirsch.
3. Optimum Design of Structures by K.l.Majid.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE747	Subject Title	Hydraulic Structures						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objective: The primary objective of the course is to impart the knowledge of the advanced design concepts of hydraulic structures.

UNIT I

Investigation and Planning -Preliminary investigations and preparation of reports, Layout of projects, Geological and hydrological investigations.

UNIT II

Analysis and Design of Dams - Earthen Dam and Gravity Dam.

UNIT III

Analysis and Design of Arch Dam, Infiltration Gallery, Collector wells.

UNIT IV

Construction of Dams - Masonry, Concrete and Earthen Dams, Foundation for Dams – Principles of Foundation treatment, Grouting methods.

UNIT V

Design of Weirs on Permeable foundation - Creep theory, Potential theory, Flow nets, design of weirs - Khosla's theory.

Learning Outcome: At the end of the course students will be able to design different types of dams and weirs.

Text book

1. Creager, W.P. Justin D, and Hinds, J., Engineering for Dams Vol. I, II and III.
2. Kushalani, K.B., Irrigation (practice and design) Vol. III and IV.
3. Nalluri C., " Hydraulic Structures" Taylor & Francis, 2001.

Department of Civil Engineering
Course Structure & Syllabus for M. Tech. in Civil Engineering
(Structural Engineering)
Batch: 2018-20

Subject Code	CE748	Subject Title	Dynamics of Earth and Environment						
LTP	4 0 0	Credit	4	Subject Category	DE	Year	2nd	Semester	III

Course Objective: To understand the fundamentals of various Earth processes and dynamic relations between various physical processes among different Environmental parameters.

UNIT 1:

Fundamentals of Atmospheric circulations: Atmosphere and it structure, Vertical profile, lapse rate, moving coordinate system, El Nino-La Nina events, Walker circulation, Madden Julian Oscillation, concepts of land sea breezes, cyclones and their formation, Indian Monsoon, Paleoclimate,

UNIT 2:

Ground water and Engineering geology: Different types of aquifers, groundwater equations, Darcy‟s Law, porosity, permeability, soil types, stress, strain, artificial recharge, rainwater harvesting, Infiltration gallery, rock strength measurements.

UNIT 3:

Ocean dynamics: Ocean physical properties, Navier stokes' equations, stability, Brunt Vaissala frequency, concept of tides, Indian Ocean dipole, global ocean currents, Western boundary currents. Planetary waves.Barotropic and baroclinic waves, Geopotential.Tsunami.

UNIT 4:

Stratigraphy and basin analysis: Concepts and principles, Lithostratigraphy, Tectonic subsidence, basin forming processes, basin margins, Various logging tools and log characteristics.

UNIT 5:

Remote sensing and Isotope geology: Electromagnetic spectrum, synthetic aperture radar, active and passive sensors, radar technology, Sensor characteristics, different dating methods, carbon dating, optical luminescence dating, corrections

Learning Outcomes: Students will be able to gain the core concepts of natural forces, disasters, causes and effects. Also they will be able to learn various numerical equations that govern the physical forces.

Text book

NavalePandharinath, C. K. Rajan, "Earth and Atmospheric Disasters Management Natural and Man-Made"