GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester I
Civil Engineering (Structural Engineering)

Subject: - Advanced Structural Analysis

Sr. No.	Course Content
1	Introduction: Principles of Virtual Work. Concepts of Flexibility: Analysis of Pin jointed and Rigid Jointed Frames, Grids by Member Approach
2	Stiffness methods: Analysis of Plane truss, plane frames, grids, space truss, space frame and composite structures by member approach. Special problems such as member discontinuities, non prismatic members, curved members, and beams on elastic supports, secondary effects due to temperature changes, Pre-strains and end displacements semi- rigid connections, plastic analysis, and effect of shear deformations by stiffness method, sub-structuring, Programming techniques for solution of large number of simultaneous equations.
3	Introduction to Non-linearity in structure and non-linear analysis.

REFERENCE BOOKS:

1. Weaver William, Gere James M., " Matrix analysis of Framed Structure", CBS Publishers, 1/e/1986
2. Wang C. K., " Intermediate Structural Analysis", McGraw Hill Co. (International Edition)
3. Jenkins W. W., " Matrix and Digital Computer Methods in Structural Analysis", McGraw Hill.

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester I
Civil Engineering (Structural Engineering)

Subject: - Structural Dynamics

Sr. No	Course Content
1	Free and forced vibration of single degree of freedom (SDOF) system, response to Harmonic, periodic, impulsive and general dynamic loading on an element. Response of SDOF to earthquake. Numerical integration Techniques.
2	Free vibration of lumped, multidegree of freedom (MDOF) system – Approximate methods for obtaining natural frequencies and mode shapes.
3	Free and forced vibration of continuous multidegree of freedom system.
4	Shear building analysis.

REFERENCE BOOKS:

1 Clough and Penzien, “
2 .Dynamics of Structures”, McGraw Hill, Kogokusha
3 Mario Paz, “Structural Dynamics-Theory and computaitons”, 2/e/1999, CBS Publishers.
4 Mukhopadhyay Mandhujit, “Vibrations, Dynamics and Stgructural Systems”, Oxford and IBH, 1/e/2000
5 Chopra Anil K., “Dynamics of Structures- Theory and Applications to Earthquake Engg.”, Prentice Hall, India, 2/e/2002

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester I
Civil Engineering (Structural Engineering)

Subject: -Theory of Elasticity and Stability

Sr. No	Course Content
1	Theory of Stresses: State of stress and strain at a point in two and three dimensions, stress and strain invariants, Hook's law, Plane stress and plain strain problems. Equations of equilibrium, boundary conditions, compatibility conditions, Airy's stress function. Two dimensional problems in Cartesian and polar coordinates, Saint Venant's principle, solution of beam problems. Torsion for non-circular sections and curved elements.
2	Classification based on Geometry, Stiffness, Materials etc. Structural elements-Fundamental behaviour of various types. Parameters of Safety and Stability: form, function, strength and stiffness. Analysis of structural elements. Buckling, post-buckling of columns, beams and frames.

REFERENCE BOOKS:

1. Schodek Daniel L, "Structures", 4/e/2002, Prentice Hall of India
2. Parikh Janak P, "Structural Analysis and Design", 1/e/2000, Charotar Pub. House
3. Ashwinikumar, "Stability of Structures", Allied Publishers, 1/e/1998
4. Timoshenko SP and Gere JM, "Theory of Elastic Stability", McGraw Hill, 1/e/1961
5. Wang C. K., "Applied Elasticity", McGraw Hill,
6. Venkatraman B & Patel A, "Structural Mechanic with introduction to Elasticity and Plasticity", McGraw Hill, 2/e/1970
7. Junnarkar SB & Shah HJ, "Mechanics of Structures Vol.-II, Charotar Publishers, 5/e/2002

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester I
Civil Engineering (Structural Engineering)

Subject: - Computer Lab For Analysis

Sr. No	Course content
1	Analysis of Structures like Truss, Continuous Beams, portal frames by Excel spread sheets OR any other means.
2.	Software Usage: Modeling and Analysis using professional software like STAAD, STRAP etc.

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester I
Civil Engineering (Structural Engineering)

Subject: - Numerical Methods (Major Elective I)

Sr, No.	Course Content
1	Error analysis, types of errors, accuracy & precision, stability in numerical analysis
2	Interpolation & extrapolation, general, interpolation formulae, numerical differentiation & integration.
3	Solution of non – linear algebraic equations, Newton – Raphson iterative method, numerical solutions of ordinary differential equations and partial differential equations using finite difference technique, its applications to structural engineering problems.
4	Solution of Eigen value problems, iterative methods & transformation methods. Applications to Structural Dynamic problems, stress problems, buckling of columns.
5	Laplace transform methods, Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation.
6	Euler's equation - Functional dependant on first and higher order derivatives

REFERENCE BOOKS:

1. Numerical methods in Engineering Salvadori & Baron
2. Numerical Methods in Finite Element Analysis Bathe & Wilson
3. Advanced Mathematics Kresysig
4. Numerical Analysis Scarborough

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester I
Civil Engineering (Structural Engineering)

Subject: - Pre-Stressed Concrete (Major Elective I)

Sr. No.	Course Content
1.	Introduction: Principles of pre-stressing - types and systems of pre-stressing, need for High Strength materials, Loading stages, Determination of losses, deflection (short-long term), camber, cable layouts.
2.	Behavior under flexure - IS codal provisions, ultimate strength, Design of flexural members including large span slabs and beams.
3.	Design for Shear, bond and torsion. Design of End blocks
4.	Design of tension members - application in the design of pre-stressed pipes and pre-stressed concrete cylindrical water tanks.
5.	Design of compression members with and without flexure - its application in the design piles.
6.	Composite beams - analysis and design, ultimate strength – their applications. Partial pre-stressing - its advantages and applications.
7.	Application of pre-stressing in continuous beams, concept of linear transformation, Concordant cable profile and cap cables.

REFERENCE BOOKS:

1. Prestressed concrete - Krishna Raju
2. Design of Prestressed Concrete Structures - T.Y.Lin
3. Fundamentals of Prestressed Concrete - N.C.Sinha & S.K.Roy S.Chand & Co.,1985.
4. Prestressed Concrete- Design and Construction - Leonhardt.F., Wilhelm Ernst and Shon, Berlin
5. Prestressed Concrete - Freyssinet
6. Prestressed Concrete, - Evans, R.H. and Bennett, E.W., Chapman and Hall

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Finite Element Method

Sr. No	Course Content
1	Introduction, concept and solution procedure for finite element method.
2	Computation of element properties like using generalized co-ordinates for one and two dimensional elements. Beam bending, plate bending and axisymmetry problems.
3	Isoparametric elements. Lagrangian and Hermitian interpolation functions.
4	Application of finite element method in structural mechanics. Dynamic Programming Organization of FEM problem.
5	Pre and Post processing introduction to FEM packages like NISA, ANSYS etc.

REFERENCE BOOKS:

1 Zienkiewicz O C., "The Finite Element Method", McGraw Hill, 14/e/1999.
2 Desai C. S. & Abel J. F., "Introduction to the Finite Element Method", First Indian Edn. 1987
3 Krishnamoorthy C.S.. "Finite Element Analysis", Tata McGraw Hill.
4 Bathe & Wilson, "Numerical Methods in Finite Element Analysis", Prentice Hall of India.
5 Chandrupatla R.R & Belegundu A.D.,"Introduction to Finite Elements in Engineering", Prentice Hall of India, 2/e/2000.

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Advanced Concrete Structures

Sr. No	Course Content
1	Flat slabs: Proportioning, analysis by direct design method and equivalent frame method, slab design and detailing.
2	Grid floors: Analysis and design by Rankine Grashoff Method, classical equivalent plate theory and IS:456 method.
3	Multi storied Buildings: Determination of dead load, live load, wind load and earthquake load on various components of the buildings and appropriate design. Detailing of reinforcement and bar bending schedule.
4	Foundations: Combined footing subjected torsion. Design of rafts. Design of pile caps.
5	Design of domes with openings.
6	Analysis and design of Folded plate roofs.
7.	Water Tanks: Shaft supported elevated water tanks. Column supported water tanks along with appropriate bracing systems.

REFERENCE BOOKS:

1 Jain & Jaikrishna, “Plain & Reinforced Concrete Structures, vol.- I & II”, Memchand & Bros, 12/e/1999
2 N. Krishna Raju, “Advanced Reinforced Concrete Design”, CBS Publications, 1/e/1986.
3 Varghese AV,”Limit State Design of Reinforced Concrete”, Prentice Hall of India, 1/e/2002.
4 Dayaratnam P et all, “Cable stayed, supported and Suspension Bridges”, Indian Institure of Bridge Engineers Universities Press, 1/e1997
5 Varghese AV,”Advanced Reinforced Concrete”, Prentice Hall of India.
6 IS Codes : IS-456, IS-875, IS-1893, IS-4326, IS-13920

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Computer Lab For Design

Sr. No	Course content
1	Design of Structural elements like Beam, Column, Slab and Foundations using Excel spread sheets or other suitable means.
2.	Software Usage: Design of various structural components using professional software like STAAD, STRAP etc.

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Structural Design Project

Students are required to carry out following in laboratory hours,

Sr. No.	Course Contents
1	Design of Earthquake & Wind resistant RCC High-rise building with Shear walls.
2.	Design Of Bunkers and Silos.
3.	Design of Industrial Shed with steel or RCC gable frame.

Reference Books :

1. Earthquake Resistant Design - Manish Shrikhande & Pankaj Agrawal
2. Plain & Reinforced Concrete Vol. II - Jain & Jaikrishna
3. Advanced reinforced concrete design - P. C. Verghese
4. Design of Steel Structures - Arya A. S
5. IS-456(2000),IS-800(2007),IS-875(1987),IS-1893(2002),
6. IS-13920(1993), IS-3370, SP-16, SP-34.
7. IITK-GSDMA guidelines for design of water retaining structures

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Advanced Foundation Engineering (Major Elective II)

Sr. No.	Course Content
1.	General requirements as per relevant IS code, bearing capacity computations as per relevant IS code including bearing capacity of stratified deposits, settlement computations as per relevant IS code, use of field tests like SPT
2.	Shallow foundations: different types, proportioning of footings for equal contact pressures, eccentrically loaded footings, soil design of combined footings, strap footing
3.	Rafts: different types, bearing capacity and settlement computations of raft on different soil deposits, determination of contact pressure under raft; concept of floating foundation basement raft, buoyancy raft
4.	Pile foundation: lateral load capacity of a pile, settlement analysis of pile group, under reamed piles, IS code provisions, pile load test
5.	Well foundations: different types, stability analysis
6.	Machine foundations: dynamic soil properties, natural frequency of machine foundation-soil system, different types of machine foundations, static and dynamic criteria for soil-foundation system, design of block foundations per IS code.
7.	Foundations on expansive soils, under reamed piles, waffle slab/raft, concept of CNS layer, chemical stabilization etc.
8.	Rigid retaining structures

REFERENCE BOOKS:

1. Kaniraj SR,"Design Aids in Soil Mech. And Foundation Engg. ", Tata McGraw Hill.
2. Swami Saran, Gopal Ranjan, "Analysis & Design of Foundaions & Retaining Structures", Sarita Prakashan.
3. Nainan P Kurian, " Design of Foundation Systems", Narose Pub. House.
4. J. E. Bowles, "Foundation Analysis and Design", McGraw Hill .

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Rehabilitation of structures (Major Elective II)

Sr. No.	Course Content
1.	Durability of concrete: Factors affecting durability of concrete, Corrosion of reinforcements in concrete, Carbonation, Chloride ingress, Alkali-silica reaction, Freeze-thaw effects, Chemical attack, Abrasion, erosion and cavitation, Weathering and efflorescence
2.	Defects and deterioration in buildings, Survey and assessment of structural conditions in RCC structures, Masonry buildings and Steel structures
3.	Non-destructive testing of concrete quality, Non-destructive testing of connections in steel, Corrosion assessment in reinforcements in RCC elements and components in steel structures
4.	Materials for repairs, rehabilitation and retrofitting processes, Methods for repairs, rehabilitation and retrofitting including surface preparation, Study of failures of buildings and lesson learnt, Role of quality control in construction as Preventive measures Maintenance of buildings, Strengthening of Earthquake-damaged buildings, Introduction to Push-over analysis

Reference Books:

1. Concrete Microstructures, properties and materials - P Kumar Mehta and Paulo J. M. Monterio
2. Properties of concrete - A. M. Neville
3. Materials for construction - Lai, James, S.
4. Structural condition assessment - Robert T. Ratay
5. Handbook of retrofitting earthquake damaged buildings
6. Learning from failure – R. N. Raiker

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Advanced steel structures (Major Elective III)

Sr. No.	Course Content
1.	Introduction: Design requirements and design process, Material behavior, mechanical properties under static load, fatigue failure under repeated load, brittle fracture under impact load, Dead loads, imposed loads, wind loads, earthquake load, earth or ground water load, indirect forces and combination of loads.
2.	Plastic Design: Plastic design of continuous beams, Rigid jointed portal frames.
3.	Multi storey building : Introduction, loading, Analysis and design for gravity and lateral forces like wind load , earthquake loads.
4.	Cable Suspended Structures: Concepts, tensile structures, bridges.
5.	Design of connections: Bolted and welded connections. Semi rigid and rigid beam-column and beam-beam connections. Beam and column splices.
6.	Load calculations and design of steel truss Bridges for roadways and railways including seismic performance.

Reference Books :

1. Design of Steel Structure - Dayarathnam, P., A.H.Wheeler, 1990
2. Design of Steel Structures – N. Subrhamanyan, Oxford..
3. Steel Structure -Design and Behaviour, Salmon, C.G., and Johnson, J.E. Harper and Row, 1980.
4. Steel Design for Structural Engineers - Kuzamanovic,B.O. and Willems,N., Prentice Hall, 1977.
5. Steel Structures - William McGuire, Prentice Hall, Inc., Englewood Cliffs, N.J.1986.

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Theory of Plates and Shells (Major Elective III)

Sr. No.	Course Content
1.	General theory of bending of plates. Derivation of differential plate equation for isotropic and orthotropic plate element
2.	analysis of isotropic plates: solution of Bi-harmonic equation by Navier's and Levy's methods for uniform pressure and concentrated point loads, strip loads and triangular loads.
3.	Particular cases or solution for rectangular and circular plates of different boundary conditions under uniformly distributed pressure.
4.	Analysis of plates by Finite difference method, Energy methods.
5.	Yield line theory of RC slab plates having different shapes, support conditions for uniformly distributed pressure.
6.	Shells: Classification of shells. Structural behaviour of shells with different boundary conditions. Membrane and bending analysis of Cylindrical and spherical (Domes) shells.

REFERENCE BOOKS:

1. Timoshenko SP and Krager SW, "Theory of Plates & Shells", McGraw Hill,
2. Chandrasekhra K, "Theory of Plates", Universities Press,

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester I
Civil Engineering (Structural Engineering)

Subject: - Basic Concepts Of Structural Behavior (Interdisciplinary Elective I)

Sr. No.	Course Contents
1	Structures and Overview: Classification, Basic issues in analysis and design of structures. Types and selection of suitable structural system.
2.	Principles Of Mechanics: Revision of internal forces and moments. Mechanical properties of building materials.
3	Introduction to Structural Analysis and Design criteria of structural Elements like truss, Cable, arch, Beam, Column and Shell.
4.	Introduction to plate and grid structures:

REFERENCE BOOKS:

1) "Structures" Daniel L.Schodek,

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. Semester II
Civil Engineering (Structural Engineering)

Subject: - Concrete Technology (Inter disciplinary Elective II)

Sr. No.	Course Contents
1	Cement: manufacturing of cement, chemical components, compounds of cement, basic equation, hydration of cement, structure of hydrated cement, volume of products of hydration, mechanical strength of cement gel, physical requirements of cement.
2.	Different types and properties of cement.
3	Different grades of concrete and their mix proportions according to IS recommended guide lines.
4	Introduction to different type of admixtures.
5	Aggregates: Sieve analysis and grading curves. Fineness modulus, grading requirements.
6	Fresh concrete: Workability of concrete, properties and testing. Mixing, compacting and curing requirements of concrete.
7	Strength of concrete: Properties and testing of hardened concrete. Destructive and nondestructive testing of concrete.

REFERENCE BOOKS :

1. Neville A. M. Properties of Concrete.
2. Gambhir M. L. Concrete Technology
3.

Practicals to be performed in Laboratory:

1. Normal consistency of cement.
2. Initial and final setting time of cement
3. Compressive strength of cement.
4. Fineness modulus of aggregates.
5. Test for workability of concrete
6. Compressive strength of concrete by destructive and nondestructive methods.

Students are supposed to do minimum two (2) concrete mix design in the remaining turns of laboratory as term work problems.