Course Name	:	**Advanced Reinforced Concrete Structures**
Course Code	:	**CEN 501**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To strengthen the basic fundamentals of design of RCC structures and to apply these basic fundamentals for the design of advanced reinforced concrete structures.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Concrete Technology:** Concrete as structural material, strength of concrete and its significance, Strength porosity relationship, Factors effecting compressive strength, Behavior of concrete under stress states, Durability of concrete and its significance, Sulphate attack, Alkali aggregate reaction, Corrosion of embedded steel in concrete and concrete deterioration due to corrosion of steel and its preventive measures.	**7**
2	**Design of Slender Columns:** Concentrically loaded slender columns, eccentrically loaded slender columns, Slender columns subjected to axial and transverse loads, Structural behavior of columns in braced and unbraced frames, Codal procedure for design of slender columns.	**6**
3	**Flat Slabs:** Elements of flat slabs, Codal procedure for design of flat slabs, Behavior of flat slab in shear, One way and two way shear, Equivalent Frame Method, Openings in flat slabs, Effect of pattern loading in flat slabs.	**6**
4	**Deep Beams**: General features, Parameter influencing design, Flexural bending and shear stresses in deep beams. Design provisions of IS-456, Checking for local failures,Strut and tie analysis of deep beams, Detailing of reinforcement in deep beams.	**6**
5	**Over Head Service Reservoir:** Special design considerations, Design requirements of materials, membrane analysis and compatibility analysis of reservoir, complete design and drawing details of an overhead service reservoir.	**8**
6	**Yield Line Analysis:** Design of slabs of various shapes and having various support conditions using yield line analysis approach.	**4**
7	**Design of Beam Column Joints:** Types of joints, Joints in multistoried buildings, Forces acting on joints, Design of joints for strength, Anchorage requirement in joints and detailing of reinforcement in joints.	**5**

Course Outcomes:

With the knowledge of this subject students shall be capable of designing and detailing of complex RCC structures.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Advanced R.C.Design by Krishna Raju.	2005
2.	Limit State Design by A.K. Jain.	1990
3.	Reinforced Concrete Structures by Park and Pauley.	1975
4.	Reinforced Concrete Structural Elements – Behaviour Analysis and Design by Purushothaman.	1984
5.	Concrete Technology by M.S. Shetty.	2006

Course Name	:	**Structural Dynamics**
Course Code	:	**CEN 502**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To impart the knowledge for analysis of structures subjected to dynamic loading.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Single Degree of Freedom Systems:** Fundamental, Mass spring damper system, Analysis of free vibrations, Response to harmonic loading, periodic loading, Impulsive loading and general dynamic loading. Generalized SDOF, Vibration analysis by Rayleigh method.	**8**
2	**Multi Degree of Freedom Systems:** Two degree of freedom system – undamped, free & forced. Multidegree of freedom system- undamped, Hozler's method, Stodola's method, Orthogonality condition, Damped system. Dynamic analysis and Response- Modal Analysis, Response spectrum analysis, Rayleigh's-Ritz method.	**12**
3	**Structures with Distributed Mass And Load**: Axial, shear and transverse vibration due to bending of beams, Uniform shear beam, Beam in bending, Numerical techniques for shear beam, Bending of beams, Forced vibration, Plates or slabs subjected to normal loads.	**10**
4	**Earthquake Motion And Response:** Introduction, Strong motion earthquake, Numerical method for spectra, Elastic spectra, Ground velocity and displacement, Inelastic spectra	**7**
5	**Machine Foundations:** Design of machine foundations, industrial floors subjected to dynamic loading.	**5**

Course Outcomes:

With the knowledge of this subject students shall be capable of analyzing the structures subjected to dynamic loads due to earthquake and vibrations due to machines etc.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Dynamics of Structures by John's Biggs.	1965
2.	Elementary Earthquake Engineering by Jai Krishna & Chander Shekhran.	2000
3.	Dynamics of Structures by Janes Biggs.	1965
4.	Earthquake Resistant Design by Dowrick-Wiley.	1978
5.	Dynamic of Structures by Walter c. Hurty & Moshe F.Rubinsten.	1964
6.	Dynamics of structures by Anil K.Chopra.	1980
7.	Dynamic of Structures by Clough and Penzein.	1975

Course Name	:	**Advanced Steel Structures**
Course Code	:	**CEN 503**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To strengthen the basic fundamentals of plastic design of steel structures.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Concept of Plastic Design**: Introduction, Theory of plastic bending, Assumptions, Bending of rectangular section, Plastic hinge, Redistribution of moments, Computation of plastic moment, Shape factor, Overload factor, Method of plastic analysis : Statical Method, Mechanism method, Upper bound, Lower bound and uniqueness theorem, Partial, Complete and over complete failure of indeterminate structures.	**7**
2	**Plastic Analysis and design of Beams:** Single span and continuous Beam, Moment Balancing Method.	**6**
3	**Plastic Analysis of Frames:** Plastic analysis and design of portal frames subjected to transverse and lateral loads, Analysis of gable frames, Analysis of multibay multistoreyed frames.	**8**
4	**Minimum Weight Design:** Concept, Assumptions, Design of frames with prismatic members, Elements of linear programming and its applications to minimum weight design problems.	**6**
5	**Deflections:** Assumption, Calculation of deflection at ultimate loads, Deflection at working loads, Rotation capacity.	**4**
6	**Secondary Design Considerations:** General, Influence of axial force on the plastic moment, Influence of shear force, Local buckling of flanges and webs, Lateral buckling, General design procedure.	**6**
7	**Introduction to Light Gauge Steel Structures.**	**5**

Course Outcomes:

With the knowledge of this subject students shall be capable of designing steel structures using theory of plastic design.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Plastic Design by Neal.	1977
2.	Plastic Design of Steel Frames by LYNN.S.Beedle.	1966
3.	The steel skeleton Volume I and II by J.F. Baker Publication English Language Book Society.	1954
4.	Steel Structure- Design and Behaviour Salmon and Johnson Publication Harper And Row.	1980
5.	Structural Steel Designer's Hand Book by Merritt.	2011
6.	Plastic analysis of steel structures by Hedge G. Philips.	1959
7.	Handbook for Structural Engineers, SP: 6(6)-1972.	1972

Course Name	:	**Advanced Structural Analysis**
Course Code	:	**CEN-504**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To learn advanced methods of structural analysis and to apply these methods for analysis of indeterminate structures.
To impart preliminary knowledge of analysing structures using finite element method.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Stiffness Matrix Method:** Basis of stiffness method, Influence coefficients, Kinematic indeterminacy, Degree of freedom, Action displacement relationship, Matrix approach to stiffness method, Transformation of axes system, Formation of load vectors, Elastic supports, Support displacements, Application of stiffness matrix method to various type of structures e.g. Continuous beams, Trusses, Frames and grids, partially discontinuous structures, Temperature effects.	**16**
2	**Flexibility Matrix Method:** Compatibility equations, Flexibility coefficients, Application of complimentary energy principles, Basis of the method, Application of flexibility matrix method to various types of structures, Analysis of pin jointed trusses, Rigid frames.	**12**
3	**Finite Element Method:** Introduction to finite element method, Theory of elasticity, Coordinate systems, Rotation of axes, Shape functions, Elements stiffness matrix and load vector, Triangular element in plane stress and strain, Numerical integration, Isoparametric elements, Rectangular elements in flexure, Triangular element, Rectangular element in plane stress and bending combined, Computer programming concepts.	**14**

Course Outcomes:

With the knowledge of this subject students shall be able to analyze the complex structures using advanced methods of analysis.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Matrix Analysis of Framed Structures by Gere and Weaver.	1980
2.	Analysis of Indeterminate Structures by C.K. Wang.	1982
3.	Finite Element Methods by Zeiekiwitz and Cheung.	1967
4.	Advance Structural Analysis by A.K.Jain.	2015
5.	Introduction to Finite Element Method by C.S.Desai and John F. Abel	1998

Course Name	:	**Pre-stressed Concrete Structures**
Course Code	:	**CEN 505**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To familiarize the students with the concept of pre-stressed concrete and design of pre-stressed concrete structures.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Principles of pre-stressing, materials of pre-stressing, pre-stressing systems, losses of prestress, short term and long term deflections of PSC members .	**8**
2	Cable profile and cable layout, concept of load balancing and stresses in cables.	**6**
3	End blocks, Stress distribution in end blocks, Anchorage zone reinforcement.	**6**
4	Design of PSC continuous beams, slab and domes, Analysis and design of PSC members for flexure, shear, bond, torsion and bearing.	**10**
5	Concepts of design of composite beams.	**4**
6	Circular pre-stressing, Types of PSC pipes, Design of PSC concrete pipes.	**8**

Course Outcomes:

With the knowledge of this subject students shall be capable of designing of PSC structures .

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Design of Prestressed Concrete structures by T.Y. Lin	1981
2.	Prestressed Concrete by G. Magnel	1954
3.	Fundamentals of Prestressed Concrete by V. Natarajan	1976
4.	Prestressed Concrete by Krishna Raju.	2012

Course Name	:	**High Rise Buildings**
Course Code	:	**CEN 506**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To familiarize the students with the methods of analysis of tall steel and concrete buildings under various loading conditions.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Structural systems and concepts,Loading: Gravity, wind and earthquake loading .	**6**
2	Application of Matrix and Approximate methods for analysis of Tall buildings, Interaction of frames, shear-wall frames, Torsion in frames.	**10**
3	Analysis of coupled shear walls, Tubular structures.	**8**
4	Sequential loading, creep and shrinkage effects on tall buildings.	**6**
5	Overall buckling analysis of frames, wall-frames, second order effects of gravity loading, P- delta analysis in steel and concrete buildings.	**12**

Course Outcomes:

With the knowledge of this subject students shall be able to analyze tall buildings under gravity, wind and earthquake loading.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Taranath Bungale, “Structural Analysis and Design of Tall Buildings” McGraw Hall 1987.	1987
2.	Beedle L.S. “Advances in Tall Buildings” VMR.	1986
3.	Kazimi. S.M.A. “Analysis of Shear walled Buildings”.	1976
4.	Schueller, “High Rise Building Structures”.	1986
5.	Tall Building Structures: Analysis and Design- B. Stafford Smith & A. Coule.	1991

Course Name	:	**Seismic Design of Structures**
Course Code	:	**CEN 507**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To impart knowledge regarding the effects of earthquakes and criteria for design of earthquake resistant structures.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Earthquakes:** Causes, Magnitude and Intensity, Ground Motions, Site Effects. Linear Earthquake analysis, Idealization of Structures.	**8**
2	**Response Spectrum:** Construction, Design Response Spectrum	**6**
3	**Introduction to Indian Standards, related to Seismic Resistant Design.** .	**4**
4	**Concepts of Seismic Design:** Earthquake Resistant Design of R.C.C Buildings	**8**
5	Analysis and Design of Shear walls, Concept of Soft Storey.	**6**
6	Concept of Base isolation and energy dissipation devices.	**4**
7	Earthquake Resistant Design of Brick Masonry Structures.	**6**

Course Outcomes:

With the knowledge of this subject students shall be capable of designing earthquake resistant structures.

S.No.	**References:**	**Year of Publication/ Reprint**
1)	Pankaj Agarwal and Manish ShriKhande, Earthquake Resistant Design of Structures, Prentice- Hall of India, 2007, New Delhi	2007
2)	Bullen K.E., Introduction to the Theory of Seismology, Great Britain at the University Printing houses, Cambridge University Press 1996.	1996
3)	Relevant code of practices.	

Course Name	:	**Plated and Shell Structures**
Course Code	:	**CEN 508**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To understand the structural behavior of shells and to analyze the various structures like rectangular plates, cylindrical shells, folded plates etc. using different methods of analysis.

Total No. of Lectures: 42

	Lecture Wise Break Up	**No. of Lectures**
1	**Pure Bending of Plates:** Slope and curvature, Relation between bending moments and curvature, Strain Energy.	**4**
2	**Symmetrical Bending Of Circular Plates:** Differential equation in polar coordinates, Uniformly loaded circular plate with or without a hole at the center and with various edge conditions.	**6**
3	**Rectangular Plates:** Differential equation of the deflection surface (small deflection theory only). Fourier series expansion for various type of loads, Rectangular plate with various loadings and edge conditions, Navier's and Levy's methods.	**8**
4	**Orthotropic Plates:** Differential equation for orthotropic plates. Rigidities for various stiffening systems, Solution for open grids, Navier's solution for orthotropic plates, Working Design of a Coffer slab Construction.	**6**
5	**Shell Structures:** Elements of Differential Geometry, Classifications of Shells, Shells of revolution loaded symmetrically with respect to their axis, Membrane theory, Edge disturbance, Application to conical shells, Spherical shells, Shells of revolution under unsymmetrical loading.	**8**
6	**Cylindrical Shells:** Membrane theory, General theory for circular cylindrical shell loaded symmetrically with respect to its axis, Circular cylindrical tank with various edge conditions.	**6**
7	**Folded Plates:** Introduction to Folded Plates, Beam action, Plate action, Stress distribution, Introduction to Simpson method.	**4**

Course Outcomes:

With the knowledge of this subject students shall be conversant with the concepts of analysis of plated and shell structures under various loading and to apply the same for design of various structures.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Timoshenko, S."Theory of Plates & Shells" – McGraw Hill.	1959
2.	Ramaswamy, "Concrete Shell roofs"	2005
3.	Szilard,R. "Theory and analysis of plates".	1973
4.	Donnel, L.H."Beams Plates and Shells".	1976
5.	Chatterjee,"Design of Shell Roofs".	1988
6.	Paduart, A."Shell Roof Analysis".	1966

Course Name	:	**Advanced Concrete Technology**
Course Code	:	**CEN 509**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To familiarize the students with latest trends in concrete technology and to design various types of concrete mixes.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Structural Concrete:** High strength concrete, materials for High Strength Concrete, Use of admixtures/superplasticizers, Mix Design procedures for High Strength Concrete mixes.	**7**
2	**Fly Ash Concrete:** Classification and properties of Fly ash, Reaction mechanism of Fly ash, Properties of Fly ash Concrete, Mix Design procedure for Fly ash Concrete.	**7**
3	**High Performance Concrete:** Materials for High Performance Concrete, Properties of HPC, Self compacting concrete and its properties, RMC , Guidelines for mix proportioning of HPC and self-compacting concrete.	**12**
4	**Polymer Concrete:** Classification of Polymer concrete, Properties of constituent materials, Polymer impregnated concrete, Properties and applications of Polymer and Polymer Impregnated concrete.	**8**
5	**Fibre Reinforced Concrete:** Properties of constituent materials, Mix proportioning guidelines, Mechanics and properties of Fibre Reinforced Concrete, Applications of fibre Reinforced Concrete.	**8**

Course Outcomes:

With the knowledge of this subject students shall be able to apply this knowledge for designing of new types of concrete being used in construction field.

S. No.	**References:**	**Year of Publication/ Reprint**
1.	"Concrete Technology" by Nevillie.	1987
2.	"Fiber Reinforced Concrete" by Bala Guru and Shah.	1992
3.	"Concrete Technology" by M.S. Shetty..	2006
4.	"New Concrete Materials - Vol.1" by Swami.	1983

Course Name	:	**BRIDGE ENGINEERING**
Course Code	:	**CEN 510**
Credits	:	3
L T P	:	3-0-0
Course Objectives:		
To familiarize with the types, suitability, selection, design criteria of various types of bridges, Introduction to Analysis and Design of various types of bridges.		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**General Bridge systems:**Considerations in alignment, Planning, Economic considerations, Aesthetics and selection of type of bridge, Bridge Hydrology, Scour Depth, Depth of foundation, Estimation of Design Discharge	**7**
2	**Loading Standards:**Specifications for loading, geometrical proportioning etc. Road, Rail-cum-Road bridges, Indian Road Congress and Indian Railway loading standards and their comparison with loading standards followed in U.K., U.S.A. and Europe.	**7**
3	**Design of Bridges:**Reinforced Concrete Bridges, Slab culverts, T-Beam Bridges, Box Girder Bridges.	**8**
4	**Bridge Bearings**	**3**
5	**Design of sub structure -** Piers and Abutments.	**4**
6	Dynamic Response of Bridges, Design considerations for pre-stressed bridges, trussed steel, Cable stayed and suspension bridges.	**9**
7	**Limit State concept for Design of RCC bridges.**	**4**

S. No.	**References:**	Year of Publication/ Reprint
1.	Design of Bridges, N.Krishna Raju, Oxford and IBH Publications	2006
2.	Victor D.J, Essential of Bridge Engineering Oxford & I.B.H. Publishing Co., New Delhi.	2014
3.	N. Rajagopalan, Bridge Superstructure, Narosa Publishing House	2006
4.	W. F. Chen and L. Duan, Bridge Engineering Handbook, CRC press	2003
5.	B. Bakht and L.G. Jaeger, Bridge Analysis Simplified, McGraw Hill	1987
6.	E. J. O'Brien, and D. L. Keogh, Bridge Deck Analysis, Taylor and Francis	1999
7.	H. Eggert and W. Kauschke, Structural Bearings, Ernst & Sohn	2002
8.	T. Y. Lin and N. H. Burns, Design of Prestressed Concrete Structures, John Wiley and Sons	1981
9.	L. Fryba, Dynamics of Railway Bridges, Thomas Telford	1996

Course Name	:	**Computer Aided Design and Expert Systems in Engineering**
Course Code	:	**CEN 511**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To impart knowledge to develop interactive software for analyzing the structures.
To develop expert systems for applications in civil engineering.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Computer Aided Design:** Introduction, Computer graphics, Geometric modeling, Three dimensional graphics, Raster graphic fundamentals, Computer aided linkage displays and synthesis, Interactive acceleration analysis.	**8**
2	**Programming Using Matrix Methods of Structural Analysis:** Assembly of matrices, Solution of equilibrium equations, Flow charts.	**10**
3	**Interactive Computer Programming:** Computer programs for design of simple civil engineering structural elements.	**8**
4	**Expert System in Engineering:** Introduction, History, Advantages and limitations of expert systems.	**5**
5	**Components of Expert Systems:** Knowledge base, Inference Engine, User's Interface.	**5**
6	**Development of Expert Systems:** Problem formulation, Application to engineering analysis & design consideration and Operations, Representative applications in civil engineering.	**6**

Course Outcomes:

With the knowledge of this subject students shall be able to develop computer programmes for analysis and design of civil engineering structures with the use of computer.

S. No.	**References:**	**Year of Publication/ Reprint**
1.	"Principle of Interactive Computer Graphics" by William M. Newman And Robert F. Sproul.	1979
2.	"Matrix Analysis of Framed Structures" by William Weaver.	1980
3.	"Introduction to Expert Systems" by Jackson, P.	1998
4.	"A guide to Expert Systems" Waterman, D.A.	1985

Course Name	:	**Liquid Retaining Structures**
Course Code	:	**CEN 512**
Credits	:	3
L T P	:	3-0-0

Course Objectives:

To impart knowledge regarding the analysis and design of various types of RCC and Steel tanks for storage of liquids.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Introduction of Containers:** Types of Tanks, Materials, Types of joints, their spacing and design, Design considerations, Cover requirement, tanks resting on ground, Circular and rectangular tanks.	**6**
2	**Under Grounds Tanks:** Circular and rectangular tanks, Problem of high ground water table, Tanks containing liquids at high temperature.	**10**
3	**Elevated Tanks:** Elevated tanks of different shapes with staging arrangement of columns / cylindrical shaft. Design of tank foundations. A complete design and drawings of high capacity O.H.S.R.	**12**
4	**Elevated Steel Tanks:** Circular tanks with conical bottom, Circular tank with segmental bottom, Design considerations, Staging, Pressed steel plate tanks.	**10**
5	**Maintenance of Liquid Retaining Structures.**	**4**

Course Outcomes:

The students will be able to understand the design concepts of structures for storage of liquids.

S. No.	**References:**	**Year of Publication/ Reprint**
1.	"Concrete Structures" by Vazirani & Ratwani.	2008
2.	"Reinforced Concrete Structures" by I.C.Syal & A.K.Goel.	2008
3.	"Design of Steel Structures" by Arya and Ajmani.	1964

Course Name:	:	**Rehabilitation of Structures**
Course No. :	:	**CEN 513**
Credits:	:	3
L T P:	:	NIL
Course Objectives:		
To understand the causes of damage and damage assessment methods of various civil engineering structures.		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Aging of structures , performance of structures , need for rehabilitation.	**6**
2	Distress in structures, damage ,source , cause , effects , case studies , Damage assessment and Evaluation models.	**8**
3	**Damage testing methods :** Non Destructive Tests and Core cutting methods.	**6**
4	**Rehabilitation methods:** Repair and rehabilitation of buildings ,Seismic strengthening of structures, use of carbon plates, FRP etc. for retrofitting of structures.	**12**
5	Concepts of structural health monitoring.	**10**

Course Outcomes:
Students will be able to assess the distress in structures and to strengthen the structures using various retrofitting techniques.

S. No.	**References:**	**Year of Publication/ Reprint**
1.	Kenneth and L. Carper	2001
2.	R N Raika	1994
3.	Structural Designers and Consultants	
4.	V K Raina	2010

Course Name:	:	**ADVANCED FOUNDATION ENGINEERING**
Course No. :	:	**CEN 514**
Credits:	:	**3**
L T P:	:	**3-0-0**

Course Objectives:

To learn the different types of foundation and their suitability for particular site and structure. To understand soil-structure interaction and calculation of allowable load and settlement of the foundation

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Shallow Foundations** : Design considerations - factors of safety (including limit state), allowable settlements, location and depth of foundations, Codal provisions. Presumptive bearing, capacity. Bearing capacity theories. Layered soils. Choice of shear strength parameters. Bearing capacity from N-values, static cone tests, plate load tests .Settlement: Total and differential settlement. Stress distribution. Consolidation settlement in clays (with correction factors). Immediate settlement. Settlement in sands from N-values, elastic solutions. Static cone tests, Plate load tests.	**14**
2	**Deep foundations:** Type of Piles. Construction methods. Axial capacity of single piles-static formulae, Skin friction and end bearing in sands and clays. Axial capacity of groups. Settlement of single piles and groups. Uplift capacity (including under-reamed piles). Negative skin friction. Pile load tests. Pile integrity tests. Codal provisions. Laterally Loaded Piles: Short and long piles; Free head and fixed head piles; Lateral load capacity of single piles; Lateral deflection; Elastic analysis; Group effect; Lateral load test; Codal provisions. Caissons and Wells.	**12**
3	**Soil structure interaction:** Introduction to soil-foundation interaction problems, soil behaviour , Foundation behaviour, Interface behaviour, Soil Foundation interaction analysis, Soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.	**6**
4	Soil Liquefaction and remedial measures, stone column, vibrfloatation, deep compaction.	**4**
5	**Foundations in difficult soils:** Expansive soils, chemically aggressive environment, soft soils, fills, regions of subsidence.	**6**

Course Outcomes:

Ability to make geotechnical design the foundation for civil engineering structure under varied field conditions.

S.No.	References:	**Year of Publication/ Reprint**
1.	Joseph E. Bowles Foundation Analysis and Design.	1997
2.	Kaniraj S.K., Design aids in soil mechanics and foundation engineering.	1988
3.	Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley,1980.	1980
4.	Joseph E. Bowles Foundation Analysis and Design.	1997

Course Name:	:	Wind Engineering
Course No. :	:	**CEN 515**
Credits:	:	**3**
L T P:	:	**3-0-0**
Course Objectives:		
To familiarize the students regarding wind loading and the effects of wind on behavior of buildings and other structures.		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Historical background to wind loading, Causes and types of wind, Factors affecting wind loading.	**8**
2	Turbulence characteristics, Bluffbody aerodynamics, Wind pressure and forces on buildings and structures.	**10**
3	Introduction to random vibrations, Alongwind and across wind response of tall buildings.	**12**
4	Towers and slender structures, Cladding systems and Mechanical damping system, wind tunnel testing and simulation techniques.	**12**

Course Outcomes:
The students will be able to analyze and design tall structures subjected to wind loads.

S. No.	References:	**Year of Publication/ Reprint**
1.	An Introduction to Wind Engineering John Wiley & Sons, E. Simiu & R.H Scalan.	1996
2.	Structural Analysis and Design of Tall Buildings- B.S Taranath.	2011
3.	Relevent IS Codes.	

Course Name:	:	Construction Engineering
Course No. :	:	**CEN 516**
Credits:	:	**3**
L T P:	:	**3-0-0**
Course Objectives:		
The students will be introduced with the various types of services/bye laws, planning, landscaping etc for the architectural design /development of residential and commercial complexes.		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Services in Residential and Commercial buildings: Sanitation, Water supply, Electrical wiring, Rain water disposal, Lighting and illumination, Calculation for these services.	**5**
2	Air Conditioning & Ventilation: Natural ventilation, Control cooling systems, Modern systems of air conditioning, Ducting systems, Different mechanical means of air conditioning.	**5**
3	Acoustics: General Principles of transmission and passage of sound, Reverberation, Absorption, Reflection, Acoustic materials and their co-efficiency, Principles of good acoustic design.	**6**
4	Thermal Insulation: Behaviour of various building materials & thermal conductivity, Fire safety devices, Thermal insulation for air conditioned interior spaces, Working out air conditioning loads for different spaces.	**6**
5	Architectural Control & Building Byelaws : Role of buildings byelaws in a city, Local byelaws and architectural controls, Façade control and zoning plans.	**6**
6	Regional Planning: Understanding of physical, social and economic parameters for regional planning.	**4**
7	Landscaping: Forces of man and nature, their relationship and effect on shaping the landscape, Site analysis, Site and structure relationship and landscape assessment.	**4**
8	**Construction Engineering management Techniques:**Modren construction management techniques like CPM/PERT , PDBM, DCPM etc. Time analysis of CPM, cost analysis of CPM. Time analysis of PERT and Cost analysis of PERT. Resourses allocation. Updating.	**6**

Course Outcomes:
With the knowledge of this subject students shall be able to carryout a complete design including site selection , planning of various services required in buildings.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	**"**Space,time & Architecture" by Siegfried Giedion.	1941
2.	"Structural Design in Architecture" by Salvadori & Levy.	1967
3.	"Structure systems" by Heihtich Engle and Salvadiri & Hellet.	2001
4.	"Services by Deshpande & Duggal.	1998
5.	"Landscape Architecture" by J.O.Simonds.	2013
6.	CPM/PERT by B.C. Punmia.	2005
7.	Network Techniques by Levy and Wiest.	1977

Course Name:	:	**Advanced Solid Mechanics**
Course No. :	:	**CEN 517**
Credits:	:	**3**
L T P:	:	**3-0-0**

Course Objectives:

To impart knowledge regarding elastic and inelastic stress analysis of basic structural elements applied to materials with linear and non-linear behavior.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Analysis of Stresses: Basic concepts of the theory of elasticity; theory of stresses; stresses on an arbitrary plane; principal stresses; stress invariants; plane state of stress; equilibrium and boundary conditions.	**6**
2	Analysis of Strains: Infinitesimal and finite strains; strain-displacement relationships; compatibility conditions; stress strain relationships; plane stress and plane strain.	**7**
3	Yield criteria and Ideally Plastic Solids: Theories of failure; Ideally Plastic solids; Stress Space and Strain space; Stress strain relations (plastic flow).	**6**
4	Bending of Beams: Introduction to Energy methods; Straight Beams and Asymmetrical bending; centre of flexure; shear stresses in thin walled open sections; bending of curved beams.	**7**
5	Torsion: Torsion of prismatic, circular, elliptical and triangular bars; Membrane Analogy; Thin wall tubes and thin rectangular sections; centre of twist and flexural centre.	**7**
6	Elastic Stability: Eular's buckling load; general treatment of column stability and buckling as an eigen value problem; Energy methods for buckling problems. (5)	**5**
7	Introduction to Composite Materials: Stress-Strain relations; Basic cases of elastic symmetry; failure criteria of composite materials.	**4**

Course Outcomes:

With the knowledge of this subject students shall be capable of understanding the behaviour of complex structures under various loading conditions. The students will also be able to develop computer programmes for the analysis of structures.

S. No.	**References:**	**Year of Publication/ Reprint**
1.	S. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw Hill Book Company, International Ed	1970
2.	D.S Chandrasekharaiah and L. Debnath, Continuum Mechanics, Prism Books Pvt. Ltd, Bangalore	1994
3.	Advanced solid Mechanics by LS Srinath.	2010
4.	I.H. Shames and F.A. Cozzarellie, Elastic and Inelastic Stress Analysis, Prentice Hall New Jersey	1992

Course Name:	:	**ADVANCED SOIL ENGINEERING**
Course No. :	:	**CEN 534**
Credits:	:	**3**
L T P:	:	**3-0-0**
Course Objectives:		
To understand the engineering properties and behavior of Soil under different field condition and loading.		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	**Origin, nature and distribution of soils:** Engineering Behaviour of Soils of India: Black cotton soils, alluvial silts and sands, laterites, collapsible and sensitive soils, aeolin deposits.	**4**
2	**Description of individual particle:** Clay mineralogy, clay-water-electrolytes. Soil fabric and structure. Effective stress principle. Steady state flow in soils. Effect of flow on effective stress.	**5**
3	**Consolidation:**One, two and three dimensional and radial consolidation. Sand drain and prefabricated drain. Variation of effective stress during consolidation, Stress-path. Shear behaviour of granular soils. Factors affecting shear beahviour. Determination of parameters. Shear behaviour of fine grained soils. Pore-pressure parameters. UU, CU, CD tests. Total and effective stress paths.	**6**
4	**Factors affecting strength:** Stress history, rate of testing, structure and temperature. Anisotropy of strength, thixotropy, creep. Stress-strain characteristics of soils. Determination of modulus values.Critical state model.	**5**
5	**Geosynthetics:** Types and functions; Materials and manufacturing processes; Principles of soil reinforcement; Design and construction of geosynthetic reinforced soil retaining structures – walls and slopes; embankments on soft soils; Geosynthetics in Pavements:Geosynthetics in roads and railways; separations, drainage and filtering in road pavements and railway tracks.	**8**
6	**Methods of site investigations:** Direct methods, semi-direct methods and indirect methods, Drilling methods. Boring in soils and rocks, methods of stabilizing the bore holes, measurement of water table, field record. Field tests: In-situ shear test, in-situ permeability test, SPT, DCPT, SCPT, in-situ vane shear test, pressure meter test, Dilatometer test Codal provisions.	**8**
7	**Slope Stability analysis**- Bishop (Rigorous and Simplified) Method, Mongestern's Method, Spencer's Method.	**6**

Course Outcomes:
To be able to ascertain the behavior of Soil as a construction material or supporting medium for Civil Engineering structures. To be able to analyze distress/failure condition relating to Soil and hence to suggest remedial measures.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Lambe and Whitman, Soil Mechanics, Wiley India	2000
2.	Swami Saran, Reinforced soil and its engineering application, I k Internationa	2010
3.	Terzaghi and Peck, Soil Mechanics in Engineering Practice, John Wiley and Sons.	1948
4.	Bowles, Physical and geotechnical properties of soils.	1984
5.	Kaniraj S.K., Design aids in soil mechanics and foundation engineering.	2004

Course Name:	:	**Design of Hydraulic Structure**
Course No. :	:	**CEN 548**
Credits:	:	**3**
L T P:	:	**3-0-0**
Course Objectives:		
To know the basics of Hydraulic structures along with the design of different components associated with it.		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Planning and investigations of reservoir and dam sites, Choice of dams, preparation andprotection of foundation and abutments.	**4**
2	Forces acting on solid gravity dam, modes of failures, stability analysis, elementary and practical profile of gravity dam, internal stresses and stress concentrations in gravity dam joints, seals, keys in gravity dams, dam safety and hazard mitigation	**8**
3	Homogeneous and zoned embankment dams, factors influencing design of embankment dams, criteria for safe design of embankment dam, steps in design of embankment dam, seepage analysis and its control through body and dam foundation, classification of rock fill dams and their design considerations**.**	**8**
4	Capacity of spillways, components and profile of different types spillways, Non conventional type of spillways, selection and design of energy dissipaters	**8**
5	Components of diversion head works and their functions, design of weirs and barrages on permeable foundations.	**6**
6	Canal regulation structures and design of cross drainage works, canal drops, operation and maintenance of canals.	**6**
7	Review of codes of practice	**2**

Course Outcomes:
Students can be able to design the various hydraulic structures on the basic of designed flood flow and their proper regulations.

S. No.	References:	**Year of Publication/ Reprint**
1.	USBR, “Design of gravity dams”, A Water Resources Technical Publication, Denver, Colorado	1976
2.	USBR, “Design of small dams”, A water resources technical publication, Oxford and IBH publishing co., New Delhi	1974
3.	Creager W P, Justin J D and Hinds J., “Engineering for dams” Nemchand and Brothers	1995
4.	Khatsuria R M, “Hydraulics of spillways and energy dissipators”, CRC Press	2005
5.	Novak P, “Hydraulic Structures”, Taylor and Francis Group publishers	2001

Course Name:	:	**Remote sensing and GIS in Engineering**
Course No. :	:	**CEN 591**
Credits:	:	**3**
L T P:	:	**3-0-0**
Course Objectives:		
To learn the basics of remote sensing and GIS. To know the application of remote sensing & GIS in various fields.		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Basic concepts of remote sensing	**3**
2	Data acquisition	**5**
3	Digital image processing, Restoration, Enhancement, Segmentation: Segmentation feature extraction, Clustering edge detection	**7**
4	Introduction to microwave remote sensing and GPS	**7**
5	Software's in GIS	**12**
6	Application to water resources and Land use.	**8**

Course Outcomes:
To apply the learnt remote sensing & GIS methods in real life problems.

S.No.	References:	**Year of Publication/ Reprint**
1.	E.D. Kaplan, Understanding GPS; Principles and Application.	2006
2.	Lillesand , T.M. and kiefer, R.W., Remote Sensing and image Interpretation, John wiley and sons, New York	2004
3.	M. L. & Chouhan, T.S., Remote Sensing and Photogrammetry – Principles and Applications, Vigyan Prakashan, Jodhpur	1998

Course Name:	:	**Numerical Methods and Optimization Techniques**
Course No. :	:	**CEN 599**
Credits:	:	**3**
L T P:	:	**3-0-0**

Course Objectives:

To understand the concept of optimization and its application in civil engineering project, and to learn the concept of relevant mathematical tools.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	RDBMS Civil Engg. Software Packages	**6**
2	Fundamentals of optimization, Statistical optimization	**6**
3	Linear Programming, Dynamic Programming.	**7**
4	Finite difference methods, Taylor's series, Fourier series	**7**
5	Different Implicit and Explicit schemes- MacCormack Scheme, Lambada Scheme, Preissmann Scheme	**8**
6	Stability analysis, Boundary Conditions, Algebra of tensors.	**8**

Course Outcomes:

Students will be able to make use of Software Packages and its application in solving the civil engineering project problems.

S.No.	**References:**	**Year of Publication/ Reprint**
1.	Software Engineering – Roger Pressman.	1982
2.	Software Development in `C' – Yashwant Kanetkar.	2013
3.	Operations Research – D.S.Heera & P.K.Gupta	2005
4.	Optimisation Theory & Applications – S.S.Rao	2014

Course Name:	:	**Design of Experiments and Research Methodology**
Course No. :	:	EN 505
Credits:	:	**3**
L T P:	:	**3-0-0**

Course Objectives:

To introduce the fundamentals of Statistical techniques, Sampling techniques, and Data collection and their interpretation.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Basic principles of design of experiment, Error analysis in experiments.	**5**
2	Concept of modeling, Different types of models, Random variables, Random numbers, and Analysis of variance.	**6**
3	Estimation of parameters, Residual analysis and model checking, Sample size problem.	**6**
4	Different types of distributions, Distribution tests, Concept of simulation, Monte Carlo simulations	**6**
5	Geostatistics	**5**
6	Que model, Time series analysis, Fitting statistics.	**5**
7	Research Methodology – Nature and objective of research, Research topic, Literature review, Formulation of problem, Research design, Sampling techniques, Data collection.	**5**
8	Statistical and sensitive analysis of data, Interpretation of result and report writing.	**4**

Course Outcomes:

Students will be able to make use of various Research methodologies and its applications in the relevant field of engineering.

S. No.	**References:**	**Year of Publication/ Reprint**
1.	Probability and Statistics for Engineers and scientists, Walpole, Myers, Myers and Ye, 7th ed, Pearson Education.	2002
2.	Statistics in Research, Bernand Ostle and Richard N.Mensing 3rd ed, Oxford & IBH Pub Co.	1975
3.	Probability and Statistics in Engineering, Hines, Montgomery, Goldsman and Borror, 4th ed, John Wiley & Sons.	2003
4.	Experimental design, Theory & application, Federer, Oxford & IBH pub Co.	1955
5.	Introduction to probability & statistics for Engineers and scientists,Sheldon M. Ross Elsevier Academic press, California, USA	1999

Course Name:	:	**Structural Engineering Lab- I**
Course No. :	:	**CEN-519P**
Credits:	:	**2**
L T P:	:	**0-0-3**
Course Objectives:		
To familiarize the students with the concepts of designing concrete mixes using different methods of proportioning and to understand the effects of various parameters		

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Effect of water/cement ratio on workability and strength of concrete	**09**
2	Effect of fine aggregate/coarse aggregate ratio on strength and permeability of concrete.	**12**
3	Study of Mix Design Methods using admixtures.	**06**
4	Stress- Strain relationship for concrete, correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.	**09**
5	Non-Destructive testing of concrete	**06**

Course Outcomes:
With the knowledge of this subject students shall be able to design various types of concrete mixes and asses the strength of RCC structures using non destructive techniques.

S. No.	**References:**	**Year of Publication/ Reprint**
1.	Concrete Manual by M.L Gambhir.	2002
2.	Material Testing Laboratory Manual by Kaushik and Kukreja.	2010
3.	Properties of Concrete by Neville.	2012

Course Name:	:	**Structural Engineering Lab- II**
Course No. :	:	**CEN-520P**
Credits:	:	**2**
L T P:	:	**0-0-3**

Course Objectives:

To understand the behavior of RCC structures under flexure, shear etc.
To impart knowledge regarding analysis and design of various structures using computer software's.

Total No. of Lectures: 42

Lecture Wise Break Up		**No. of Lectures**
1	Study of behaviour of Beams under flexure, shear, Study of behaviour of under reinforced and over reinforced beams.	**18**
2	Analysis and Design of structures with different configurations using computer softwares and preparation of detailed drawings.	**24**

Course Outcomes:

With the knowledge of this subject students shall be able to analyze and design the various civil engineering structures with using latest computational techniques.

S. No.	References:	
1.	Concrete Manual by M.L Gambhir.	2002
2.	Concrete Manual by Kaushik and Kukreja.	2010
3.	Relevant software manuals.	