GUJARAT TECHNOLOGICAL UNIVERSITY

Civil Engineering

ADVANCE ENGINEERING MATHEMATICS

SUBJECT CODE: 2130002

B.E. 3rd SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	30	0	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction to Some Special Functions:** Gamma function, Beta function, Bessel function, Error function and complementary Error function, Heaviside's function, pulse unit height and duration function, Sinusoidal Pulse function, Rectangle function, Gate function, Dirac's Delta function, Signum function, Saw tooth wave function, Triangular wave function, Halfwave rectified sinusoidal function, Full rectified sine wave, Square wave function.	02	4
2	**Fourier Series and Fourier integral:** Periodic function, Trigonometric series, Fourier series, Functions of any period, Even and odd functions, Half-range Expansion, Forced oscillations, Fourier integral	05	10
3	**Ordinary Differential Equations and Applications:** First order differential equations: basic concepts, Geometric meaning of y' = f(x,y) Direction fields, Exact differential equations, Integrating factor, Linear differential equations, Bernoulli equations, Modeling , Orthogonal trajectories of curves.Linear differential equations of second and higher order: Homogeneous linear differential equations of second order, Modeling: Free Oscillations, Euler- Cauchy Equations, Wronskian, Non homogeneous equations, Solution by undetermined coefficients, Solution by variation of parameters, Modeling: free Oscillations resonance and Electric circuits, Higher order linear differential equations, Higher order homogeneous with constant coefficient, Higher order non homogeneous equations. Solution by [1/f(D)] r(x) method for finding particular integral.	11	20

4	**Series Solution of Differential Equations:** Power series method, Theory of power series methods, Frobenius method.	03	6
5	**Laplace Transforms and Applications:** Definition of the Laplace transform, Inverse Laplace transform, Linearity, Shifting theorem, Transforms of derivatives and integrals Differential equations, Unit step function Second shifting theorem,	09	15
	Dirac's delta function, Differentiation and integration of transforms, Convolution and integral equations, Partial fraction differential equations, Systems of differential equations		
6	**Partial Differential Equations and Applications:** Formation PDEs, Solution of Partial Differential equations f(x,y,z,p,q) = 0, Nonlinear PDEs first order, Some standard forms of nonlinear PDE, Linear PDEs with constant coefficients,Equations reducible to Homogeneous linear form, Classification of second order linear PDEs.Separation of variables use of Fourier series, D'Alembert's solution of the wave equation,Heat equation: Solution by Fourier series and Fourier integral	12	15

Reference Books:

1. Advanced Engineering Mathematics (8th Edition), by E. Kreyszig, Wiley-India (2007).
2. Engineering Mathematics Vol 2, by Baburam, Pearson
3. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005)
4. R. V. Churchill and J. W. Brown, Fourier series and boundary value problems (7th Edition), McGraw-Hill (2006).
5. T.M.Apostol, Calculus , Volume-2 (2nd Edition), Wiley Eastern , 1980

Course Outcomes:

1. Students will be able to**apply**the concept of Fourier series and use it to find Fourier expansion for periodic or non-periodic functions.
2. Students will **EVALUATE** Laplace transform for various functions and apply them to find Laplace transform or inverse Laplace transform of functions of t and also find solution of initial value problems.
3. Students will **learn**various methods for finding the general solution of ordinary differential equations and use it to engineering problems.
4. Students will be able to **differentiate**the singularities and apply it to find series solution of second order ordinary differential equations.
5. **Understand** partial differential equations and know various methods to solve partial differential equations.Students will **examine** the concepts the method of separation variables and use it to find solutions of Heat equation, Laplace equation and Wave equation.

	PO1	PO2	PO3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO-1	2		3										1			
CO-2	1		1										2			
CO-3			2										1			
CO-4	3		1		2								2			
CO-5	3	2	2										2	2		

Co- Po Justification

Mapping	Level	Justification

		Students will be able to
CO1-PO1 Co2 – PO1	2 1	Use knowledge of Fourier series and Fourier integral Laplace transform in various engineering problem and find its optimum solution.
CO1-PO3 CO2-PO3 CO3-PO3 CO4-PO3 CO5-PO3	3 1 2 1 2	Use the knowledge of mathematical concept, students can design and develop solutions for engineering problems.
CO5-PO3	2	Understand mathematical problem's analysis
CO4- PO1 CO5-PO1	3 3	Know various data analysis approach involves solving IT engineering problems
CO4-PO1 CO5-PO2	3 2	Know fundamental concepts of o.d.e which will help in solving IT engineering problem

Co- Pso Justification

Mapping	Level	Justification
		Students will be able to
CO1-PSO1 CO2-PSO1 CO3-PSO1 CO4-PSO1 CO5-PSO1	1 2 1 2 2	Apply knowledge of mathematics inreal life problems using engineering principles and find its solution.
CO5-PSO2	2	Analyze and understand the mathematical problem and make it easy and find it solution.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

MECHANICS OF SOLIDS

SUBJECT CODE: 2130003

B.E. 3RD SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Syllabus:

1	Introduction: Definition of space, time, particle, rigid body, deformable body. Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces. Fundamental Principles of mechanics: Principle of transmissibility, Principle of superposition, Law of gravitation, Law of parallelogram of forces.
2	Fundamentals of Statics Coplanar concurrent and non-concurrent force system: Resultant, Equilibrant, Free body diagrams. Coplanar concurrent forces: Resultant of coplanar concurrent force system by analytical and graphical method, Law of triangle of forces, Law of polygon of forces, Equilibrium conditions for coplanar concurrent forces, Lami's theorem. Application of these principles. Coplanar non-concurrent forces: Moments & couples, Characteristics of moment and couple, Equivalent couples, Force couple system, Varignon's theorem, Resultant of non-concurrent forces by analytical method and graphical method, Equilibrium conditions of coplanar non-concurrent force system, Application of these principles.
3	Applications of fundamentals of statics Statically determinate beams: Types of loads, Types of supports, Types of beams; Determination of support reactions, Relationship between loading, shear force & bending moment, Bending moment and shear force diagrams for beams subjected to only three types of loads :i) concentrated loads ii) uniformly distributed loads iii) couples and their combinations; Point of contraflexure, point & magnitude of maximum bending moment, maximum shear force.
4	Friction Theory of friction, Types of friction, Static and kinetic friction, Cone of friction, Angle of repose, Coefficient of friction, Laws of friction, Application of theory of friction: Friction on inclined plane, ladder friction, wedge friction, belt and rope friction.

5	Centroid and moment of inertia Centroid: Centroid of lines, plane areas and volumes, Examples related to centroid of composite geometry, Pappus – Guldinus first and second theorems. Moment of inertia of planar cross-sections: Derivation of equation of moment of inertia of standard lamina using first principle, Parallel & perpendicular axes theorems, polar moment of inertia, radius of gyration of areas. Examples related to moment of inertia of composite geometry,
6	Simple stresses & strains: Basics of stress and strain: 3-D state of stress (Concept only) Normal/axial stresses: Tensile & compressive Stresses :Shear and complementary shear Strains: Linear, shear, lateral, thermal and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio, Modulus of rigidity and bulk modulus and relations between them with derivation. Application of normal stress & strains: Homogeneous and composite bars having uniform & stepped sections subjected to axial loads and thermal loads, analysis of homogeneous prismatic bars under multidirectional stresses.
7	Stresses in Beams: Flexural stresses – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I,T,Angle, channel sections Shear stresses – Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.
8	Torsion: Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity.
9	Principle stresses: Two dimensional system, stress at a point on a plane, principal stresses and principal planes,Mohr's circle of stress, ellipse of stress and their applications
10	Physical & Mechanical properties of materials: (laboratory hours) Elastic, homogeneous, isotropic materials; Stress –Strain relationships for ductile and brittle materials, limits of elasticity and proportionality, yield limit, ultimate strength, strain hardening, proof stress, factor of safety, working stress, load factor, Properties related to axial, bending, and torsional & shear loading, Toughness, hardness, Ductility ,Brittleness
11	Physical & Mechanical properties of materials: (laboratory hours) Elastic, homogeneous, isotropic materials; Stress –Strain relationships for ductile and brittle materials, limits of elasticity and proportionality, yield limit, ultimate strength, strain hardening, proof stress, factor of safety, working stress, load factor, Properties related to axial, bending, and torsional & shear loading, Toughness, hardness, Ductility ,Brittleness

Reference Books:

1. Engineering Mechanics statics by R. C. Hibbeler, McMillan Publication.
2. Engineering Mechanics by R S Khurmi
3. Engineering Mechanics by S S Bhavikatti
4. Mechanics for Engineers - Statics Fourth Edition, by F. P. Beer and E. R. Johnson
5. Engineering Mechanics, 2nd ed. — MK Harbola
6. Introduction to Mechanics — M K Verma
7. An Introduction to Mechanics — D Kleppner & R Kolenkow
8. Principles of Mechanics — JL Synge & BA Griffiths
9. Mechanics — JP Den Hartog
10. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
11. Engineering Mechanics by Shames I. H., P H I India.
12. Mechanics of Structure Vol. I S. B. Junnarkar & H. J. Shah
13. Mechanics of Materials E. P. Popov
14. Strength of Materials G. H. Ryder
15. Mechanics of Materials Timoshenko and Gere
16. Mechanics of Materials Beer and Johnston.

Course outcomes: After compelleting this course, the students wil be able to:

1. **Define** fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering.
2. **Solve** principles of statics to determine reactions & internal forces in statically determinate beams.
3. **Discuss** behaviour & properties of engineering materials, basics of simple machines and their working mechanism.
4. **Determine** centroid and moment of inertia of a different geometrical shape and able to understand its importance.
5. **Explain** basics of friction and its importance through simple applications.
6. **Illustrate** the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2130003.1	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-	-	-
2130003.2	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-	1	-
2130003.3	3	2	1	-	-	-	-	-	-	-	-	1	3	2	-	-	-
2130003.4	3	1	-	-	-	-	-	-	-	-	-	-	2	1	-	1	-
2130003.5	3	2	-	-	-	-	-	-	-	-	-	1	2	2	-	-	-

2130003.6	3	2	1	1	-	-	-	-	-	-	-	1	2	1	1	-	-
2130003	3	1.83	1	1	-	-	-	-	-	-	-	1	2.5	1.5	1	1	-

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2130003.1-PO1	3	Basic knowledge of fundamental principles of mechanics will be gained by students.
2130003.1-PO2	2	Concepts of principles of equilibrium will be useful to analyze various practical problems of engineering.
2130003.1-PO12	1	Deliver fundamental knowledge about mechanics which will further be utilized in the context of technological changes.
2130003.2-PO1	3	Basic knowledge of Principle of statics gained by the students is important for the solution of engineering problems
2130003.2-PO2	2	Basic knowledge of determining reaction and internal forces are useful in anlaysis of statically determinate beam
2130003.3-PO1	3	Students will gain the fundamental knowledge of behaviour and properties of engineering material and basics of machine and working mechanism
2130003.3-PO2	2	The concept of properties of civil engineering material is useful in identify and application in engineering problem.
2130003.3-PO3	1	The learing output of simple machine is useful for design solution of various system components as per specific need.
2130003.3-PO12	1	The current knowledge of material is needed to apply with respect to future technological changes.
2130003.4-PO1	3	Students use the knowledge of determining centroid and moment of inertia of geometrical shape for solution of problem
2130003.4-PO2	1	Importance of centorid and moment of inertia of any geometrical shape in analysis and design of structure is essencial.
2130003.5-PO1	3	Basic knowledge of friction will be important for solution of specific engineering problem concern with friction
2130003.5-PO2	2	Students will be able to identify the importance of simple application of friction in problem analysis.
2130003.5-PO12	1	Students will be recognize the need of friction for design system components to meet specific need.
2130003.6-PO1	3	Basic knowledge of different types of stresses will be gained by students.
2130003.6-PO2	2	Different types of stresses learn by the students is useful in various problem analysis
2130003.6-PO3	1	Students should understand the effect of various loading subjected to structure for evaluate design solution
2130003.6-PO4	1	Students will be capable of describing process of design of experiment , analysis and interpretation of data for various material of structure.
2130003.6-PO12	1	The knowlwdge of stress and strain based on various loading condition on structure will be helpful for life long learning for students.

GUJARAT TECHNOLOGICAL UNIVERSITY

Civil Engineering

DESIGN ENGINEERING

SUBJECT CODE:2130005

3rd semester

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks			Practical Marks		
L	T	P	C	ESE (E)	PA (M)		PA (V)	PA (I)	
					PA	ALA	ESE		
0	0	3	3	0	0	0	80	20	100

Sr. No.	POs	Statement
1	PO207.1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	PO207.2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	PO207.3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	PO207.4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	PO207.5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	PO207.6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	PO207.7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	PO207.8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	PO207.9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	PO207.10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large,

		such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	PO207.11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	PO207.12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Sr. No.	COs	Statement
1	C207.1	Observe, Identify and define simple/ complex problems of day to day lives present in Industry/ Society.
2	C207.2	Apply knowledge of basic science and engineering fundamentals to demonstrate an in-depth technical competence.
3	C207.3	Integrate & summaries prior studies through various observations from various angles.
4	C207.4	Apply problem-solving methodologies to generate, evaluate and justify innovative solutions by designing and conducting experiments, analyzing and interpreting the data.
5	C207.5	Demonstrate the ability to execute designs with an ability to communicate effectively, making economical and multitasking solution.

CO – PO & PSO Matrix

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
1	CO1	2		2	3	3	3	3		3	2	2	3	3	3	3	2	-
2	CO2	3	3	3	3	3	3	2	2	3	3	3	2	2	2	2	3	-
3	CO3	2	2	3	3	2	2	2	2	3	2	3	2	2	2	2	3	-
4	CO4	3	2		2	3	2	2		3	2	3	3	2	3	3	3	-
5	CO5	2		2		3	3	3	2	3	3	3	3	1	2	3	3	-
Avg. Mapi.		2	2	3	3	3	3	2	2	3	2	3	3	2	2	3	3	-

CO – PO Justifications

CO	PO	Value	Justifications
1	1	2	Basic knowledge is can be enhanced
1	2		
1	3	2	Student can apply knowledge for the solution of problem
1	4	3	Student can convert problem from complex to simple form
1	5	3	Student can apply direct approach
1	6	3	Student can serve society after this.
1	7	3	Student can serve society by protecting environment and looking to its sustainability.
1	8		
1	9	3	Students can learn how to work in teamwork for betterment.
1	10	2	Students can serve as a bridging gap through communicating how to apply knowledge for

			betterment.
1	11	2	Students can have idea about cost of the project and how to manage with existing resources.
1	12	3	Students cannot forget this topic for longer period of time.

CO	PO	Value	Justifications
2	1	3	student can apply basic knowledge
2	2	3	student can analyse the problem with basic science and engineering fundamentals
2	3	3	students can design the element
2	4	3	students can analyse or design the complex elements into simpler ones
2	5	3	students can check their problem via software also
2	6	3	student can design of the problem solution for betterment of society
2	7	2	Student can serve society by protecting environment and looking to its sustainability.
2	8	2	students can use their ethics in coordination with the rules given in IS codes
2	9	3	students can learn how to work in teamwork for betterment
2	10	3	students can communicate somewhat with designer
2	11	3	students can work on project scheduling and management with existing resources
2	12	2	Students cannot forget this topic for longer period of time.

CO	PO	Value	Justifications
3	1	2	student can apply basic knowledge
3	2	2	student can analyse the element
3	3	3	students can design the element
3	4	3	students can analyse or design the problem
3	5	2	students can check their problem via software also
3	6	2	students can have general idea about whole problem
3	7	2	some what environmental friendly
3	8	2	students have to follow rules given in IS codes for design
3	9	3	students can have general idea about whole structure
3	10	2	students can communicate some what with designer
3	11	3	students can have idea about cost of the structure.
3	12	2	Students can not forget this topic for longer period of time.

CO	PO	Value	Justifications
4	1	3	students can write complete report for design of problem identified
4	2	2	students can analyse the whole problem
4	3		
4	4	2	students can find the element to be modified in the project/ model for better functioning.
4	5	3	students can analyse and design whole problem definition via software.
4	6	2	Students can have total idea about the problem
4	7	2	students can work on sustainability of the project on environment
4	8		
4	9	3	Students can do analysis or design of project/ model individually also.
4	10	2	Student can communicate fully with designer also.
4	11	3	students can have total idea about cost and erection/ implementation of problem/ model.
4	12	3	Students can not forget this topic for longer period of time.

CO	PO	Value	Justifications
5	1	2	student can apply basic knowledge of drawing
5	2		
5	3	2	Students can understand design of problem/ model via drawing also.
5	4		
5	5	3	Students can generate drawings using software.
5	6	3	Students can interpret the whole design through drawings.
5	7	3	Students can analyze the practical importance of the project/ model to the environment
5	8	2	Students can check the drawings whether it was created as per IS rules or not.
5	9	3	Students can interpret the drawing of structure individually also.
5	10	3	Students can communicate in terms of technical data for the projects as a whole.
5	11	3	Students can handle the projects as a whole.
5	12	3	Students cannot forget this topic for longer period of time.

GUJARAT TECHNOLOGICAL UNIVERSITY
Civil Engineering
Surveying
SUBJECT CODE ::130601
B.E. 3rd SEMESTER

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory marks			Practical Marks			
				ESE	PA(M)		PA(V)		PA	
			C	(E)	PA	ALA	ESE	OEP	(I)	
3	0	2	5	70	20	10	30	0	20	150

Syllabus:

1	Plane Table Survey: Introduction, principle, instruments, setting up the plane table, methods of plane tabling, advantages, sources of Errors.
2	Theodolite Traversing: Introduction, definitions, the vernier transit theodolite, temporary and permanent adjustment of theodolite, measuring horizontal and vertical angles, methods of traversing, closing error, computation of latitudes and departure, check in closed and open traverse, balancing of traverse, Gale's table, traverse area, omitted measurements.
3	Trigonometric levelling: Indirect levelling, levelling on steep ground- methods.
4	Curves: Introduction, theory and setting out methods of simple circular curve, elements of a compound and reverse curves, transition curve, types of transition curve, combined curve, types of vertical curves
5	Computation of Areas: Methods to compute area of traverse- Determining areas from Plans, Trapezoidal rule- Simpson's rule, Use of planimeter Computation of Volumes- Volume from cross sections, Trapezoidal and Prismoidal formulae, Prismoidal correction, Curvature correction, Determination of capacity of reservoir and volume from borrow pits
6	Hydrography: Introduction, purposes, control points, soundings, instruments & methods of locating soundings.
7	Setting out Works: Building, Culvert, Bridge, Tunnel Term

course Objectice students will be able to

1. **Perform** field work for plane table and Theodolite traverse survey and **Prepare** drawing . .
2. **Analyze** levels through tacheometric trigonometric levelling
3. **Design** and setting of curves .
4. To **evaluate** areas and volumes of earth work .
5. To **describe** hydrological survey
6. **develop** layouts for foundation, culverts.

C O-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
130601.1	3		-		2	-	-	-	2	-		-	3		-	-	-
130601.2	3			-	2	-	-	-	2	-		-	3	-	-	-	-
130601.3	3	2		-	2		-	-	2	-		-	3	2	-	-	-
130601.4	3				2				1				3				
130601.5	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**		**-**	**3**			**-**	**-**
130601.6	3				2				2				3				
130601	3	2			2				1.8				3	2			

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
130601.1PO1	3	Engineering knowledge relating to plane table and theodolite is essential for conducting the survey
130601.1PO5	2	Modern tools are used in surveying
130601.1 PO9	2	Team work is essential in survey procedure
130601.2PO1	3	Engineering knowledge relating to trigonometric levelling is essential for conducting survey
130601.2PO5	2	Modern tools are used in surveying
130601.2 PO9	2	Team work is essential in survey procedure
130601.3PO1	3	Engineering knowledge relating to curve setting is essential for conducting the survey
130603.3 PO2	2	Designing of curve isrequired for setting out the curve
130601.3PO5	2	Modern tools are used in surveying
130601.3 PO9	2	Team work is essential in survey procedure
130601.4PO1	3	Engineeiring knowledge is essential for calculating areas and volumes
130601.4PO5	2	Modern tools are used in surveying
130601.4 PO9	1	Team work is essential in survey procedure
130601.5PO1	3	Engineering knowledge is essential for conducting hydrological

		survey
130601.5PO5	2	Modern tools are used in surveying
130601.5 PO9	2	Team work is essential in survey procedure
130601.6PO1	3	Engineering knowledge is required for laying out of foundation of building bridges etc.
130601.6PO4	2	Modern tools are used in surveying
130601.6 PO9	2	Team work is essential in survey procedure

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)

FUILD MECHANICS

SUBJECT CODE: 2130602

B.E. 3rd Semester

Rationale:

1. To develop a basic understanding about the properties of fluids, their behavior under static and dynamic conditions.
2. To enable the students to apply the basic principles of Fluid Mechanics to solve real life problems

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Contents:

Sr No	Contents	Teaching Hrs	Weightage (%)
1	**Module 1:Properties of Fluids** Mass density, specific weight, specific gravity, specific volume, vapour pressure, compressibility, elasticity, surface tension, capillarity; Newton's law of viscosity, classification of fluids, dynamic viscosity, kinematic viscosity, variation of viscosity with temperature; Basic concept applicable to fluid mechanics.	4	10
2	**Module 2: Fluid Statics** *Measurement of Pressure*: Pressure variation in static fluid, PASCAL's law, Units and scale of pressure measurement- Atmospheric pressure, Absolute pressure, Gauge pressure, and Vacuum pressure, Hydrostatic paradox, Piezometer, U-Tube manometer, Single column manometer, U-tube differential manometer, Inverted U-tube differential manometer, micromanometers, Mechanical pressure gauges. *Hydrostatic force on plane and curved surface :* Total pressure and center of pressure, pressure diagram, Total pressure on plane surfaces and curved surfaces depth of center of pressure, Practical applications of Total pressure and Center of pressure. *Buoyancy and Flotation:* Buoyant force, Buoyancy and Center of Buoyancy, Archimedes Principle, Metacentre and Metacentric height, Equilibrium of floating and	12	25

	submerged bodies, Metacentric height evaluation –theorectical and experimental method, Oscillation of floating body *Fluids in Relative Equilibrium:* Static fluid subjected to uniform linear acceleration, Liquid containers subjected to constant horizontal acceleration,Liquid containers subjected to constant vertical acceleration, Liquid containers subjected to constant rotation.		
3	**Module 3:Fluid Kinematics** Fluid flow methods of analysis of fluid motion, Streamlines, Path lines, Streak lines and Stream tubes. Types of fluid flow-Steady and unsteady flow, Uniform and non-uniform flow, Laminar and turbulent flow, Reynolds number, Reynolds experiment, Rotational and Irrotational flow, Subcritical, critical and Supercritical flow, Compressible and Incompressible flow, One, Two and three dimensional flow, Circulation and vorticity, Velocity potential and stream function, flow net, Source, Sink and Doublet.	6	10
4	**Module 4: Fluid Dynamics** Euler's equation, Bernoulli's equation, Energy correction factor	3	10
5	**Module 5: Flow Measuring Devices** Measurement of discharge- Venturimeter, Orificemeter, Nozzlemeter, Rotometer. Measurement of velocity-Pitot tube. Orifice- classification. Flow through reservoir opening i.e. orifice, trajectory of free jet, hydraulic coefficients, Experimental determination of hydraulic coefficients, Small and large orifice, Time of emptying a tank with orifice. Mouthpiece- classification, External cylindrical mouthpiece, Convergent –divergent mouthpiece, Borda's mouthpiece. Notches and weirs-discharge over rectangular notch and triangular notch. Velocity of approach, End Contractions. Cippoletti notch. Time of emptying a tank with notch or weir, Ventilation of weir, Sutro weir.	8	25
6	**Module 6: Flow Immersed Past Bodies** Drag and lift, Types of drag, Drag on sphere, cylinder, flat plate and Airfoil, Karman vortex street, Effect of drag, Development of lift, Magnus effect, Circulation and lift characteristics of airfoils.	4	10
7	**Module 7 Compressible Flow** Basic equations, Mach number, Mach cone, Area-velocity relationship, Propagation of sound wave, Stagnation properties.	5	10

Reference Books:

1. Engineering Fluid mechanics, K.L. Kumar, 8th Edition S. Chand & Company Ltd.
2. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
4. Fluid Mechanics, A.K. Jain, 4th edition, Khanna Publishers.

Course Outcomes:

After successful completion of the course the students shall be able to:

1. **Describe** types of fluid and determine their properties.
2. **Measure** pressure and calculate hydrostatic pressures and forces on flat/curved surfaces.
3. **Analyze** forces on floating and immersed bodies and **understand** fluids in relative equilibrium.
4. **Know** the basics of fluid kinematics and dynamics and understand and apply the Bernoulli principle.
5. **Explain** the concept of drag and lift on various objects.
6. **Calibrate** fluid flow measuring devices like venturimeter, orificemeter, notches, orifice and mouthpieces.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
C302.1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
C302.2	-	3	3	3	3	-	-	-	-	-	-	-	-	1	-	2	-
C302.3	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3	-
C302.4	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-	2	-
C302.5	2	2	-	-	-	-	-	-	-	-	-	-	1	2	-	3	-
C302.6	-	-	-	3	3	-	-	-	-	-	-	-	-	2	1	3	-
C302	2.50	2.66	3	3	3												

3: Strong 2: Moderate 1: Low -:NA

CO –PO Mapping & Justification

Mapping	Level	Justification
2130602.1-PO1	3	Students will be able to learn the various properties of fluid by using the principles of science.
2130602.2-PO2	3	By using the principles of engineering science and mathematics, students will be able to analyse the forces/pressures acting on the body.
2130602.2-PO3	3	The design of various hydraulic structures can be carried out by calculating the forces acting on the body of the structure.
2130602.3-PO1	2	Students can apply their knowledge of mathematics, science and engineering fundamentals to understand the concept of floating and immersed bodies..
2130602.3-PO2	3	By using the principles of engineering science and mathematics, students will be able to analyse the forces/pressures acting on the the floating and submerged bodies.
2130602.3-PO3	3	Students will be able to perform various experiments to calculate the pressure forces acting on the body.
2130602.3-PO4	3	Tools such as manometer, pressure gauge and barometer can be used to perform the practical to find out the high and low pressures.
2130602.4-PO1	3	Students can apply their knowledge of mathematics, science and engineering fundamentals to understand the concept of fluid kinematics and dynamics.
2130602.4-PO4	3	Students will be able to perform various experiments on the basis of Bernoulli's equation to calculate the flow through pipes.
2130602.4-PO5	3	Engineering tools such as hydraulic bench, flow measuring devices can be used to calculate the discharge through various objects.
2130602.5-PO1	2	Students will be able to learn the concept of lift and drag forces by

		using the principles of fundamental engineering.
2130602.5-PO2	2	The drag and lift forces acting on the suface / body can be analysed by knowing various principles of engineering science.
2130602.6-PO4	3	Students will be able to calculate the velocity, discharge and head losses through various bodies by doing experiments using the instruments like venturimeter, notches, weirs, orifices and mouthpiece.
2130602.6-PO5	3	Engineering tools such as venturimeter, notches, weirs, orifices and mouthpiece can be used to calculate the discharge through various objects.

Program Specific Outcome (PSOs)

1. Gradates will be able to actively apply technical knowledge and skill for solving day to day civil engineering problems.
2. Graduates will be able to engage themselves to achieve expertise in design and analysis of structures by modern civil engineering tools.
3. Graduates will be able to become responsible technocrats to deliver environmental friendly sustainable solutions.
4. Graduates will be able to capable of design functionally efficient structures knowing the latest development in the field of civil engineering.
5. Graduates will be able to pursue their career as professional entrepreneur by using knowledge and soft skills.

CO-PSO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
C302.1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
C302.2	-	3	3	3	3	-	-	-	-	-	-	-	-	1	-	2	-
C302.3	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3	-
C302.4	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-	2	-
C302.5	2	2	-	-	-	-	-	-	-	-	-	-	1	2	-	3	-
C302.6	-	-	-	3	3	-	-	-	-	-	-	-	-	2	-	3	-
C302	2.50	2.66	3	3	3												

3: Strong 2: Moderate 1: Low -:NA

CO-PSO Mapping & Justification

Mapping	Level	Justification
2130602.1-PSO1	2	By knowing various types of fliud and their properties, graduates will be able to apply their knowledge to solve day to day fluid related problems.
2130602.2-PSO2	1	By Measure pressure and calculate hydrostatic pressures and forces on flat/curved surfaces, graduates will be able to enguage themselves in the design of flow mwasuring devices.
2130602.2-PSO4	2	By Measure pressure and calculate hydrostatic pressures and forces on flat/curved surfaces, graduates use their knowledge in design of latest flow measuring devices.
2130602.3-PSO2	3	By analyzing forces on floating and immersed bodies and understanding

		fluids in relative equilibrium, graduates will be able to apply their knowledge in the design of ships, hot air bloons etc.
2130602.3-PSO4	3	By analyzing forces on floating and immersed bodies and understanding fluids in relative equilibrium, Graduates will be able to capable of design functionally various ships knowing the latest development in the field of fluid mechanics.
2130602.4-PSO4	2	By Knowing the basics of fluid kinematics and dynamics and understand and apply the Bernoulli principle, graduates will be capable to desion various hydraulic structures.
2130602.5-PSO1	1	Knowledge of drag and lift on various objects can help to graduates to solve problems realted to submarine, pressure hull,tower or sail etc.
2130602.5-PSO2	2	Knowledge of drag and lift on various objects can enguage the graduateds in the design of submarine, pressure hull, hydroplane etc.
2130602.5-PSO4	3	By knowing the concepts of drag and lift forces, graduates will be able to design efficient devices with latest technology in the field of civil engineering.
2130602.6-PSO2	2	Knowledge of fluid flow measuring devices like venturimeter, orificemeter, notches, orifice and mouthpieces can help to graduates to solve pipe flow and open channel flow problems.
2130602.6-PSO4	3	By calibrating flow measuring devices, graduats will apply their knowledge to develop laboratoty to solve fliud mechanics problems.

GUJARAT TECHNOLOGICAL UNIVERSITY
CIVIL ENGINEERING
GEOTECHNICS & APPLIED GEOLOGY
SUBJECT CODE:2130606
B.E. 3rd Semester

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Syllabus:

1	Introduction: Definition, brief history, scope, and limitations of Geotechnics.
2	Origin and Nature of Soil: Geological cycle, Physical and chemical agencies for soil, Formation - residual, transported, alluvial, marine and lacustrine, glacial drift, loess and colluvial soils. General characteristics of different types of soils. Overview of different types of soils in Gujarat / India.
3	Index Properties, Relationships and Tests: Phase diagram, Basic terms and definitions, Functional relationships,Determination of index properties, Relative density for granular soil.
4	Particle Size Analysis: Size and nomenclature of soil particles as per IS, Sieve analysis, Sedimentation analysis, Particle size distribution curve and its uses.
5	Soil Structure: Shape of the particles, Texture and structure of the soil. Types of the structure, properties, conditions for the formation of different structures.
6	Soil Consistency: Consistency limits and its determination, different indices, Field moisture equivalent, Activity, Sensitivity & Thixotropy of soil.
7	Soil Classification: Objectives, Basis, Textural, Unified soil classification, IS classification method, group index. Field identification and General characteristics of the soil.
8	Soil Water: Free water and held water, Structural water and absorbed water, Capillary
9	Permeability and Seepage: Darcy's law and its validity, Factors affecting permeability, Laboratory permeability tests, Introduction to field permeability test, Permeability of stratified soil masses, Laplace equation (2-D), Seepage pressure, Quick condition, Flow net, its characteristics and application.
10	Physical Geology: Branches and scope of Geology; Surface processes and landforms: Weathering and

	Erosion; Introduction to geological agents (river, wind, oceans, glaciers, groundwater) and their actions (erosion, transport and deposition). Interior of the Earth: internal structure of earth, study of core, mental and crust of the Earth. Processes responsible for volcanism (Process of volcanic eruption, types of volcanoes and volcanic hazard) and earthquake (Causes of earthquake occurrence, Distribution (seismic zoning), Seismo-tectonic setup of India, seismic hazard: Tsunamis, Active fault rupture, liquefaction). Plate Tectonics: Introduction to the concept of plate tectonics, mechanism responsible for plate movement, types of plate boundaries, processes and features associated with plate boundaries. Continental drift and sea floor spreading.
11	Mineralogy and Petrology: Physical properties of minerals, major rock forming minerals, occurrence and use of minerals. Introduction to major rock types (Igneous, sedimentary and metamorphic rocks); their genesis, classification and structures; engineering properties of rocks, advantages and disadvantages of different rock types at constructions sites.
12	Geological time-scale and laws of stratigraphy: Introduction to geological time scale and stratigraphy, Laws of stratigraphy.
13	Structural geology: Introduction to primary and secondary geological structures. Study of geological faults, folds, joints and active faulting. Their origin, types and engineering consideration. Geological mapping: study of Strike and dip using models and numerical problems, preparation of geological cross section.
14	Hydrogeology: Hydrological cycle and groundwater occurrence.
15	Geology in Civil Engineering: Geological investigations during planning for tunnels, dams-reservoirs-runways-roads and buildings. Landslide and mass movement: Introduction, types, mitigation and prevention of landslide and mass movement. Remote sensing and Geographical Information System (GIS): Introduction to remote sensing and GIS, use of remote sensing and GIS in geological investigations and geological hazard mitigation.

Course outcomes: After compelleting this course, the students wil be able to:

1. **Define** soil formation, types of soils and its index properties and interrelationships between various soil parameters.
2. **Explain** the different types of soil, particle size and atterberg's indices, classification systems, types of soil water found in nature and it's permeability characteristic.
3. **Understand** processes and geological agents involved in the shaping surface of the earth and explain the the internal structure of the Earth..
4. **Discuss** hazards due to volcanic and seismic activity.
5. **Differentiate** major mineral and rock types in hand-specimen.
6. **Classify** different types of geological structure and understand hazard associated under specified geologic conditions.

CO-PO mapping

	PROGRAM OUTCOMES												PEOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2130606.1	3	2	-	1	-	-	-	-	-	-	-	-	3	1	-	-	-
2130606.2	3	3	1	-	-	-	-	-	-	-	-	-	3	1	-	-	-
2130606.3	2	-	-	2	2	-	2	-	-	-	-	1	2	2	-	-	-
2130606.4	2	2	2	2	-	-	-	-	-	-	-	2	2	-	-	-	-
2130606.5	2	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-	-
2130606.6	2	2	2	2	-	-	-	-	-	-	-	2	2	-	2	-	-
2130606	2.33	2.2	1.75	1.8	2	-	2	-	-	-	-	1.75	2.33	1.5	2	-	-

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2130606.1-PO1	3	Basic knowledge of formation of soil mass and index properties will be gained by students.
2130606.1-PO2	2	Can correlate different index properties and understand phase diagram. predict soil behaviour
2130606.1-PO4	1	Can prepare soil classification system.
2130606.2-PO1	3	Basic knowledge of partical size and consistency limits will be gained.
2130606.2-PO2	3	Will be able to find permeability characteristics.
2130606.2-PO3	1	Can get solution of index properties related problems.
2151603.3- PO1	2	Apply the knowledge of internal structure of the Earth
2151603.3- PO4	2	**Conduct investigations of complex problems** internal structure of the Earth
2151603.3- PO5	2	select, and apply appropriate techniques internal structure of the Earth
2151603.3- PO7	2	**Environment and sustainability** internal structure of the Earth
2151603.3- PO12	1	**Life-long learning** internal structure of the Earth
2151603.4 -PO1	2	Apply the knowledge of hazards due to volcanic and seismic activity
2151603.4-PO2	2	analyze complexengineering problems hazards due to volcanic and seismic activity
2151603.4-PO3	2	Design solutions for hazards due to volcanic and seismic activity
2151603.4-PO4	2	**Conduct investigations of complex problems** hazards due to volcanic and seismic activity
2151603.4-PO12	2	**Life-long learning** hazards due to volcanic and seismic activity
2151603.5 -PO1	2	Apply the knowledge of mineral and rock types in hand
2151603.5-PO2	2	analyze complexengineering problems mineral and rock types in hand
2151603.5-PO3	2	Design solutions for mineral and rock types in hand
2151603.5-PO4	2	**Conduct investigations of complex problems** mineral and rock types in hand
2151603.5-PO12	2	**Life-long learning** mineral and rock types in hand
2151603.6 -PO1	2	Apply the knowledge of different types of geological structure
2151603.6-PO2	2	analyze complexengineering problems different types of geological structure
2151603.6-PO3	2	different types of geological structure
2151603.6-PO4	2	**Conduct investigations of complex problems** different types of geological structure
2151603.6-PO12	2	**Life-long learning** different types of geological structure

GUJARAT TECHNOLOGICAL UNIVERSITY

Civil Engineering

BUILDING CONSTRUCTION

SUBJECT CODE: 2130607

B.E. 3rd SEMESTER

Programme: CIVIL ENGINEERING	Degree: B.E.
Course Code: 2130607 Building Construction	Semester: 3
Credits: 4	Contact hours: 3 (Theory) + 1 (Tutorial)

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Syllabus:

1	Introduction: Overview of construction practices, theory and methods. Subsurface Investigation: Objectives, methods of boring like wash boring, percussion etc. Shallow Foundations: Necessity, types, setting out, excavation, construction, failures of foundation and remedial measures.
2	MasonaryConstruction : a) Stone masonary: Technical terms, lifting appliances, joints, types – random (un-coursed) rubble, coursed rubble, dry rubble masonry, Ashlar masonry-Ashlar fine, chamfered fine. b) Brick masonary: Technical terms, bonds in brick work-English bond, single & double Flemish bond, garden wall bond, raking bond, Dutch bond. c) Composite masonary: Stone facing with brick backing, brick facing with concrete backing. d) Hollow concrete blocks and construction. Plain and Reinforced Concrete Construction: Pre-cast and cast-in-situ Construction
3	Doors and Windows : a) Doors: Location, technical terms, size, types, construction, suitability. b) Windows: Factors affecting selection of size, shape, location and no. of windows, types, construction, suitability, fixtures and fastenings. c) Ventilators: Ventilators combined with window, fan light. Stairs and Staircases: Definition, technical terms, requirements of good stair, fixing of going and rise of a step, types of steps, classification, example – stair planning, elevators, escalators.
4	Floorings : Introduction, essential requirements of a floor, factors affecting selection of flooring material, types of ground floors, brick, flag stone, tiled cementconcrete, granolithic, terrazzo, marble, timber flooring, upper floor- timber, timber floor supported on RSJ flag stone floor resting on RSJ, jack arch floor, reinforced concrete floor, ribbed floor, pre cast concrete floor. A.C. sheet roofs – fixing of A.C. sheets, laying of big six sheets, G.I. Sheets roofs, slates, flat roof – advantages, dis-advantages, types of flat terraced roofing.Plastering, pointing and painting. Timbering in trenches , types of scaffoldings, shoring, underpinning
5	Special Treatments: Fire resistant, water resistant, thermal insulation, acoustical construction and anti-termite treatment.

6	Green Building: Principles, Concepts and Case study

Course Outcomes:

1. **Explain** various types of shallow foundation and sub-surface soil investigation.
2. **Identify** causes of failure and **give** remedial measures.
3. **Enumerate and Describe** various structural building components.
4. **Discuss** various temporary works for new and existing buildings, roofs & lintels.
5. **Recognize and select** special treatments - water resistance, thermal insulation acoustical for construction in building.
6. **Understand** concept ofgreen buildings.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
C307.1	3	-	2	-	-	-	-	-	-	-	-	3	3	-	2	3	-
C307.2	3	-	-	-	-	3	-	-	-	-	-	2	3	-	-	3	-
C307.3	3	-	3	-	-	-	-	-	-	-	-	3	3	-	3	3	-
C307.4	3	-	-	-	-	-	-	-	2	2	-	3	3	-	-	3	-
C307.5	3	-	-	-	-	2	-	-	2	2	-	3	3	-	2	3	-
C307.6	3	-	3	-	-	-	3	-		2	-	3	2	-	3	3	-
C307	3		2.66			2.5	3		2.00	2.00		3.00	2.83	-	2.50	3.00	-

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2130607.1-PO1	3	Basic knowledge of construction and civil engineering for soil investigation
2130607.1–PO3	2	Design the deep and shallow foundation
2130607.1-PO12	3	Continuous learning new codes and design in the foundation
2130607.2-PO1	3	Basic knowledge of construction and civil engineering
2130607.2-PO6	3	Knowledge for assessment of the safety of the building
2130607.2 –PO12	2	Continuous learning new methods of prevention of failures but not much modification is needed.
2130607.3 -PO1	3	Knowledge of basic components of the buildings and its construction activities.
2130607.3 -PO3	3	Designing the basic structural components of the buildings.
2130607.3 -PO12	3	Continuous knowledge of the latest design and improvement in design as per National Building Code.
2130607.4 -PO1	3	Basic civil engineering knowledge for construction
2130607.4 -PO9	2	Team work for preparing and making models of temporary works
2130607.4 -PO10	2	For renovating existing building the approval and communication between various people needed.

2130607.4 -PO12	3	Continuous learning for improving the design with latest materials.
2130607.5 –PO1	3	Knowledge of basic civil engineering
2130607.5 –PO6	2	Gives health assessment and safety from various hazards like thermal and termite protection
2130607.5 –PO9	2	Team work for assessing various work
2130607.5 –PO10	2	For improving existing building the approval and communication between various people needed.
2130607.5 –PO12	3	Continuous learning for improving the design with latest materials.
2130607.6 -PO1	3	Basic civil engineering knowledge for construction
2130607.6 -PO3	3	Designing the basic structural components of the green buildings
2130607.6 –PO7	3	Environmental friendly and sustainable buildings.
2130607.6 -PO10	2	Improving the ill effects of the buildings various commutationsand seminars needed.
2130607.6 -PO12	3	Continuous learning for improving the design of the green building.
2130607.1– PSO1	3	Students will be able to apply technical knowledge for soil investigation
2130607.1–PSO3	2	With soil and subsurface soil investigation students will design efficient structures
2130607.1-PSO4	3	With soil and subsurface soil investigation the students will able to give good design of civil infrastructure.
2130607.2-PSO1	3	Students will be able to apply technical knowledge for failures of foundation.
2130607.2-PSO4	3	With knowledge of failures of foundations the students will able to give good design of civil infrastructure.
2130607.3-PSO1	3	Students will be able to apply technical knowledge for designing various components of building
2130607.3-PSO3	3	With knowledge of various building components students will design efficient structures
2130607.3-PSO4	3	With knowledge of various building components the students will able to give good design of civil infrastructure.
2130607.4-PSO1	3	Students will be able to apply technical knowledge for various temporary works needed in building construction
2130607.4-PSO4	3	With knowledge for various temporary works needed in building construction the students will able to give good design of civil infrastructure.
2130607.5-PSO1	3	Students will be able to apply technical knowledge various acoustical and fire resistant structures
2130607.5-PSO2	2	With knowledge of various acoustical and fire resistant structures the students will build good environmental friendly building.
2130607.5-PSO3	2	With knowledge of various acoustical and fire resistant structures students will design efficient structures
2130607.5-PSO4	3	With knowledge various acoustical and fire resistant structures the students will able to give good design of civil infrastructure.
2130607.6-PSO1	2	Students will be able to apply technical knowledge for construction of green building
2130607.6-PSO2	3	With knowledge for construction of green building the students will build good environmental friendly building.
2130607.6-PSO3	3	With knowledge for construction of green building students will design efficient structures

2130607.6-PSO4	3	With knowledge for construction of green building the students will able to give good design of civil infrastructure.

GUJARAT TECHNOLOGICAL UNIVERSITY
Civil Engineering
DESIGN ENGINEERING
4th Semester

Sr. No.	POs	Statement
1	PO207.1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	PO207.2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	PO207.3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	PO207.4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	PO207.5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	PO207.6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	PO207.7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	PO207.8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	PO207.9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	PO207.10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	PO207.11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	PO207.12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Sr. No.	COs	Statement
1	C207.1	Observe, Identify and define simple/ complex problems of day to day lives present in Industry/ Society.
2	C207.2	Apply knowledge of basic science and engineering fundamentals to demonstrate an in-depth technical competence.
3	C207.3	Integrate & summaries prior studies through various observations from various angles.
4	C207.4	Apply problem-solving methodologies to generate, evaluate and justify innovative solutions by designing and conducting experiments, analyzing and interpreting the data.
5	C207.5	Demonstrate the ability to execute designs with an ability to communicate effectively, making economical and multitasking solution.

Sr. No.	PSOs	Statement
1	PSO207.1	The students will be actively engaged in problem solving using Civil Engineering principles to address the evolving needs of the society.
2	PSO207.2	The students will be able to achieve expertise in design and analysis of various Civil Engineering structures.
3	PSO207.3	The students will be responsible technocrats in terms of ethics and value systems for socio-economic and environmentally sustainable development.
4	PSO207.4	The students will develop awareness for different codes of practice and bye laws to generate engineering designs which considers functionality, aesthetic, safety and cost effectiveness of civil Infrastructure.
5	PSO207.5	The students will have required knowledge, skills and attitude to choose and become an entrepreneur in Civil Engineering profession.

CO – PO & PSO Matrix

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
1	CO1	2		2	3	3	3	3		3	2	2	3	3	3	3	2	-
2	CO2	3	3	3	3	3	3	2	2	3	3	3	2	2	2	2	3	-
3	CO3	2	2	3	3	2	2	2	2	3	2	3	2	2	2	2	3	-
4	CO4	3	2		2	3	2	2		3	2	3	3	2	3	3	3	-
5	CO5	2		2		3	3	3	2	3	3	3	3	1	2	3	3	-
Avg. Mapi.		2.40	2.33	2.50	2.75	2.80	2.60	2.40	2.00	3.00	2.40	2.80	2.60	2.00	2.40	2.6	2.8	-

CO – PO Justifications

CO	PO	Value	Justifications
1	1	2	Basic knowledge is can be enhanced
1	2		
1	3	2	Student can apply knowledge for the solution of problem
1	4	3	Student can convert problem from complex to simple form
1	5	3	Student can apply direct approach
1	6	3	Student can serve society after this.
1	7	3	Student can serve society by protecting environment and looking to its sustainability.
1	8		

1	9	3	Students can learn how to work in teamwork for betterment.
1	10	2	Students can serve as a bridging gap through communicating how to apply knowledge for betterment.
1	11	2	Students can have idea about cost of the project and how to manage with existing resources.
1	12	3	Students cannot forget this topic for longer period of time.

CO	PO	Value	Justifications
2	1	3	student can apply basic knowledge
2	2	3	student can analyse the problem with basic science and engineering fundamentals
2	3	3	students can design the element
2	4	3	students can analyse or design the complex elements into simpler ones
2	5	3	students can check their problem via software also
2	6	3	student can design of the problem solution for betterment of society
2	7	2	Student can serve society by protecting environment and looking to its sustainability.
2	8	2	students can use their ethics in coordination with the rules given in IS codes
2	9	3	students can learn how to work in teamwork for betterment
2	10	3	students can communicate somewhat with designer
2	11	3	students can work on project scheduling and management with existing resources
2	12	2	Students cannot forget this topic for longer period of time.

CO	PO	Value	Justifications
3	1	2	student can apply basic knowledge
3	2	2	student can analyse the element
3	3	3	students can design the element
3	4	3	students can analyse or design the problem
3	5	2	students can check their problem via software also
3	6	2	students can have general idea about whole problem
3	7	2	some what environmental friendly
3	8	2	students have to follow rules given in IS codes for design
3	9	3	students can have general idea about whole structure
3	10	2	students can communicate some what with designer
3	11	3	students can have idea about cost of the structure.
3	12	2	Students can not forget this topic for longer period of time.

CO	PO	Value	Justifications
4	1	3	students can write complete report for design of problem identified
4	2	2	students can analyse the whole problem
4	3		
4	4	2	students can find the element to be modified in the project/ model for better functioning.
4	5	3	students can analyse and design whole problem definition via software.
4	6	2	Students can have total idea about the problem
4	7	2	students can work on sustainability of the project on environment
4	8		
4	9	3	Students can do analysis or design of project/ model individually also.
4	10	2	Student can communicate fully with designer also.
4	11	3	students can have total idea about cost and erection/ implementation of problem/ model.

4	12	3	Students can not forget this topic for longer period of time.

CO	PO	Value	Justifications
5	1	2	student can apply basic knowledge of drawing
5	2		
5	3	2	students can understand design of problem/ model via drawing also.
5	4		
5	5	3	Students can generate drawings using software.
5	6	3	Students can interpret the whole design through drawings.
5	7	3	Students can analyze the practical importance of the project/ model to the environment
5	8	2	Students can check the drawings whether it was created as per IS rules or not.
5	9	3	Students can interpret the drawing of structure individually also.
5	10	3	Students can communicate in terms of technical data for the projects as a whole.
5	11	3	Students can handle the projects as a whole.
5	12	3	Students cannot forget this topic for longer period of time.

GUJARAT TECHNOLOGICAL UNIVERSITY

Civil Engineering

ENGINEERING ECONOMICS AND MANAGEMENT

SUBJECT CODE: 2140003

B.E. 4thSEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	0	3	70	20	10	0	0	0	100

Course Objectives:

At the end of the course, students should be able to:

1. Students will be able to **describe** the fundamental theories and principles used in Engineering Economics and Management and to some extent are able to **compare** and **evaluate** them.
2. Students will be able to **learn**, **compare** and **apply** various cost concepts and analysis techniques.
3. They will be able to **understand a**business plan for an entrepreneurship project using economics and Management fundamentals.
4. Students will be able to **apply** the knowledge and techniques, skills and methods to become successful project leaders.
5. Students will be able to apply professional ethical principles and corporate social responsibility concepts in personal, financial and economic decisions for sustainable growth and development.
6. Students will be able to analyze and think through basic economic problems of our country.

Syllabus:

1	Introduction to Economics; Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand & Supply; meaning, determinants, law of demand, law of supply, equilibrium between demand & supply Elasticity; elasticity of demand, price elasticity, income elasticity, cross elasticity
2	Theory of production; Theory of production; production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur), Law of variable proportions & law of returns to scale Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, numerical
3	Markets

	Markets; meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National Income; meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal income, disposal income.
4	Basic economic problems Basic economic problems; Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control
5	Money Money; meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR.
6	Introduction to Management Introduction to Management; Definitions, Nature, scope Management & administration, skill, types and roles of managers Management Principles; Scientific principles, Administrative principles, Maslow's Hierarchy of needs theory
7	Functions of Management Functions of Management; Planning, Organizing, Staffing, Directing, Controlling (meaning, nature and importance) Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization.
8	Introduction to Marketing management Introduction to Marketing management; Marketing Mix, concepts of marketing, demand forecasting and methods, market segmentation Introduction to Finance Management; meaning, scope, sources, functions
9	Introduction to Production Management Introduction to Production Management; definitions, objectives, functions, plant layout-types & factors affecting it, plant location- factors affecting it. Introduction to Human Resource Management; definitions, objectives of manpower planning, process, sources of recruitment, process of selection
10	Corporate Social Responsibility Corporate Social Responsibility; meaning, importance Business Ethics; meaning, importance.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
CO 1	3	1	1										1				
CO 2			2								1						

CO 3			2					2	1		2						
CO 4	2							2		2						1	
CO 5								1									
CO 6						2											

Mapping & Justification

Mapping	Level	Justification
CO1-PO1	3	Basic knowledge of theories and principles used in Engineering Economics and Management will be gained by students.
CO1 -PO3	1	Concepts learned in this subject will be useful to analyze situations related organization of various management and finance related activities in industry.
CO2-PO11	2	Various cost concepts and analysis techniques will be useful for effective finance management of the projects.
CO3-PO11	2	Students they can analyze the requirements for an entrepreneurship project using economics and Management fundamentals.
CO2-PO3	2	Basic concepts of cost, money, banking, national income will enable students to analyze various industry problem and they will be able to apply learned concepts to solve those problems.
CO3-PO3	3	Students use the knowledge of the subject to **design a**business plan for an entrepreneurship project using economics and Management fundamentals.
CO6-PO6	2	Knowledge about nation's economy and various economic problems and understand the consequent responsibilities relevant to the professional engineering practice.
CO4-PO8,10	2	Students will be able to **apply** the knowledge and techniques, skills and methods to become successful project leaders.
CO5-PO8	1	Students will be able to apply professional ethical principles and Corporate social responsibility concepts in personal, financial and economic decisions for sustainable growth and development.
CO6-PO6	2	The students should analyze basic economic problems of our country and follow informed and responsible engineering practices
CO1-PSO1	1	Students grasp and apply chemical engineering fundamentals considering the impact of, economy.
CO6-PSO4	1	The students should know about economic and management concepts to develop soft-skills and leadership attitude to work on industrial and professional arena.

GUJARAT TECHNOLOGICAL UNIVERSITY
Civil Engineering
Advance Surveying
SUBJECT CODE ::140601
B.E. 4th SEMESTER

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory marks			Practical Marks			
				ESE	PA(M)		PA(V)		PA	
			C	(E)	PA	ALA	ESE	OEP	(I)	
3	0	2	5	70	20	10	30	0	20	150

Syllabus:

1	Tacheometric Surveying : Introduction, purpose, principle, instruments, stadia constants, methods of tacheometry, anallatic lens, subtense bar, field work in tacheometry, reduction of readings, errors and precisions.
2	Geodetic Surveying- Principle and Classification of triangulation system- Selection of base line and stations- Orders of triangulation- Triangulation figures- Station marks and signals- marking signals- Extension of base, Reduction of Centre, Selection and marking of stations
3	Theory of Errors : Introduction, types of errors, definitions, laws of accidental errors, laws of weights, theory of least squares, rules for giving weights and distribution of errors to the field observations, determination of the most probable values of quantities
4	Field Astronomy: Introduction, purposes, astronomical terms, determination of azimuth, latitude and longitude.
5	Aerial photogrammetry : Introduction, Principle, Uses, Aerial camera, Aerial photographs, Definitions, Scale of vertical and tilted photograph,, Ground Co-ordinates, Displacements and errors, Ground control, Procedure of aerial survey, Photomaps and mosaics, Stereoscopes, Parallax bar.
6	Modern Surveying Instruments: Introduction, Electromagnetic spectrum, Electromagnetic distance measurement, Total station.
7	Remote Sensing- Introduction, Principles of energy interaction in atmosphere and earth surface features, Image interpretation techniques, visual interpretation, Digital image processing, Global Positioning system
8	Geographical Information System- Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, Geospatial analysis, Integration of Remote sensing and GIS and Applications in Civil Engineering.

course Objectives students will be able to

1. P**erform** tacheometric survey and Geodetic survey .
2. E**evaluate** errors in survey measurements .
3. R**elate** Knowledge of astronomy for solving civil engineering problems.
4. D**escribe** large scale survey work through aerial photography and of aerial survey .
5. **Use** of Total Station and other modern Instruments .
6. **Application** of GIS and remote sensing in map analysis .

C O-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2140601.1	3		-		2	-	-	-	2	-		-	3		-	-	-
2140601.2	3	1		-	-	-	-	-		-		-	3	-	-	-	-
2140601.3	3			-	2		-	-	2	-		-	3		-	-	-
2140601.4	3				2				2				3				
2140601.5	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**		**-**		**-**	**3**			**-**	**-**
2140601.6	3	2			2				2				3	2			
2140601	3	1.5			2				2				3	2			

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2140601.1.PO1	3	Engineering knowledge relating to tacheometry and Geodetic surveying
2140601.1.PO5	2	Modern tools are used in surveying
2140601.1.PO9	2	Team work is essential in survey procedure
2140601.2.PO1	3	Engineering knowledge relating to theory of error is essential for conducting survey
2140601.2.PO2	1	Knowledge of theory of error is essential for problem solving
2140601.PO1	3	Engineering knowledge relating to Astronmy is essential for conducting Astronomical survey
2140601.3PO5	2	Modern tools are used in surveying
2140601.3PO9	2	Team work is essential in survey procedure
2140601.4PO1	3	Engineeiring knowledge is essential for Aerial photogrammetry and aerial camera
2140601.4.PO5	2	Modern tools are used in surveying
2140601.4.PO9	2	Team work is essential in survey procedure
2140601.5.PO1	3	Engineering knowledge is essential for utilising Total station and other modern survey instruments
2140601..5.PO5	2	Modern tools are used in surveying

2140601.6.PO1	3	Engineering knowledge is required for applying GIS and other modern survey instruments like Total station
2140601.6.PO5	2	Modern tools are used in surveying
2140601.6PO9	2	Team work is essential in survey procedure

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

STRUCTURAL ANALYSIS-I

SUBJECT CODE: 2140603

B.E. 4th Semester

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	2	0	6	70	20	10	30	00	20	150

Syllabus:

1	Fundamentals of Statically Determinate Structures: Types of statically determinate & indeterminate structures, static and kinematic indeterminacy, stability of structures, principle of superposition, Maxwell's reciprocal theorems.Computation of internal forces in statically determinate structures such as plane truss, plane frame, grids.
2	Displacement of Determinate Beams and Plane Truss: Differential equation of elastic curve, relation between moment, slope and deflection, Macaulay's method, Moment Area Method, Conjugate Beam Method applied to beams. Joint displacement of determinate plane truss using unit load method.
3	Direct and Bending stresses: Members subjected to eccentric loads, middle third rule, kernel of section, chimney subjected to wind pressure, retaining walls, dams subjected to hydraulic pressure.
4	Columns and Struts: Buckling of columns, different end conditions, effective length, least radius of gyration, Euler's and Rankine's formulae, columns with initial curvature, eccentrically loaded columns, columns with lateral loading.
5	Arches, Cables and Suspension Bridges: Calculation internal forces in three hinge arches with circular and parabolic shapes subjected to various types of loading. Forces and end actions in cables due to various types of loading. Unstiffened three hinged parabolic and cantenory type suspension bridge.
6	Thin cylinder: Analysis of thin cylinder and spherical vessels under pressure.
7	fixed Beams & Consistent Deformation Method: Computation of fixed-end actions for various types of loads and secondary Effects using basic principles, beams of varying moment of inertia.

	Analysis of propped cantilever beams & beams of varying moment of inertia using Consistent Deformation Method
8	Strain Energy Resilience, strain energy due to axial loads & flexure, proof resilience, modulus of resilience, impact loads, and sudden loads.

Reference Books:

1. Junarkar S.B. & Shah H.J.; Mechanics of Structures Vol-I; Charotar publishing house, Anand

2. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, New Delhi

3. Popov E.P.; Engineering Mechanics of Solids; Prentice Hall of India, New Delhi

4. Ryder G.H.; Strength of Materials; Mcmillan

5. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi

6. Hibbler R C; Mechanics of Materials; Pearson Education

7. Hibbler R C; Structural Analysis; Pearson Education

Course outcomes: After completing this course, the students wil be able to:

1. **Memorize** principles of statics to determine reactions & internal forces in structures.
2. **Compare** displacements of statically determinate structures.
3. **Solve** stresses due to axial & eccentric loading.
4. **Distinguish** strain energy stored in a body.
5. **Evaluate** buckling load for columns & struts with different end conditions.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2140603.1	3	1	1	-	-	-	-	-	-	-	-	-	3	3	-	2	1
2140603.2	3	2	2	-	-	-	-	-	-	-	-	-	3	2	-	1	1
2140603.3	3	3	2	1	-	-	-	-	-	-	-	-	3	2	-	2	1
2140603.4	2	2	1	-	-	-	-	-	-	-	-	-	3	2	-	1	1
2140603.5	3	2	3	-	-	-	-	-	-	-	-	-	3	2	-	1	1
2140603	2.8	2	1.8	1	-	-	-	-	-	-	-	-	3	2.2	-	1.4	1

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2140603.1-PO1	3	Basic knowledge of principles of statics and statically determinate structure will be gained by students.

2140603.1-PO2	1	Concepts of principles of statics and statically determinate structure will be useful to analyze various practical problems of engineering.
2140603.1-PO3	1	Deliver knowledge about statically determinate structure which will helpful in design solution.
2140603.2-PO1	3	Basic knowledge of deformation of statically determinate structure is important for the solution of engineering problems.
2140603.2-PO2	2	Basic knowledge of displacement are useful in analysis of statically determinate structures.
2140603.2-PO3	2	Students will use the knowledge of analytical result for development of solution.
2140603.3-PO1	3	Importance of determining stresses loading is essential for analysis of various structural components.
2140603.3-PO2	3	Stresses formulated due to axial and eccentric loading will be important for analysis of specific structural problem.
2140603.3-PO3	2	Students will be able to design the problem related to eccentric loading for structure under consideration.
2140603.3-PO4	1	Students will be able to interpret the results to provide concusion
2140603.4-PO1	2	Students will understand concepts of strain energy related to structure to calculate and explain the importance of strain energy stored in body.
2140603.4-PO2	2	Students will be capable of identify the important concept of strain energy stored in a body.
2140603.4-PO3	2	The knowledge of srain energy is useful for the solution of design problem based on the concept on srain energy for specific problem.
2140603.5-PO1	3	Students will gained the knowledge of different end conditions of the column which will be necessary for analysis and design of column for any structural system.
2140603.5-PO2	2	Learning of buckling load for column is useful for analyse the column with different end conditions.
2140603.5-PO3	3	Design solution for various types of column will be done by using fundamental knowledge related to columns.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

NUMERICAL AND STATISTICAL METHODS FOR CIVIL ENGINEERING

SUBJECT CODE: 2140606

B.E. 4th Semester

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	30	0	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Syllabus:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	Probability		
1	**Reorientation:** Definition of probability, Exhaustive events, Pair wise independent events, Multiplicative law of probability, Conditional probability, Baye's theorem	03	07
2	**Probability Distributions:** Random variable, Mathematical Expectation, Standard Deviation, Binomial, Poisson and Normal distributions, Mean, Median, Mode	05	12
	Statistics		
3	**Descriptive Statistics:** Mean, Median, Mode, Standard deviation, Skewness	03	08
4	**Correlation and Regression:** Bivariate distribution, Correlation coefficients, Regression lines, Formulas for Regression coefficients, Rank correlation	04	10
5	**Curve Fitting:** Fitting of Linear, Quadratic, Exponential and Logarithmic curves, Least squares method	03	08
	Numerical Methods		
6	**Finite Differences and Interpolation:** Finite Differences, Forward, Backward and Central operators, Interpolation by polynomials: Newton's forward ,Backward interpolation formulae, Gauss &Stirling's central difference formulae , Newton's divided and Lagrange's formulae for unequal Intervals	08	15
7	Numerical Integration: Newton-Cotes formulaTrapezoidal and Simpson's formulae, error formulae,Gaussian quadrature formulae	03	08
8	Solution of a System of Linear Equations: Gausselimination, partial pivoting , Gauss-Jacobi and Gauss-Seidel methods	03	07
9	Roots of Algebraic and Transcendental Equations: Bisection, false position, Secant and Newton-Raphsonmethods, Rate of convergence	04	10

10	Numerical solution of Ordinary Differential Equations: Taylor series method, Euler method, Runge-Kutta methodof order four, Milne's Predictor-Corrector method	06	15

Course Outcomes:

CO-1: Understand, identify and apply the basic concepts of probability, random variables, probability distribution.
CO-2:Solve engineering problem using Statistical methodology and tools.
CO-3: Interpret and Compute descriptive statistics using Numerical and graphical techniques.
CO-4: Recognize, understand and apply the basic concepts used in regression, curve fitting and finite differences of tabulated data.
CO-5:Able to evaluate integration and differentiation using Numerical methods.
CO-6:Select and apply the appropriate method to solve algebraic and transcendental equations, ordinary differential equation and system of linear equation.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2		3	1							1	1				
CO2	3	2		3	1							1	1	2			
CO3	3	2		3	1					1		1	2	2			
CO4	3	2		3	1							1	2	3			
CO5	3	3		3	1			1		1		1	1				
CO6	3	3		3	1					1		1	1				
	2.83	2.33		3	1			1		1		1	1.33	2.33			

Mapping & Justification:

Mapping	Level	Justification
CO1-PO1	2	Student will be able to use probabilistic reasoning to solve the complex engineering problems involving random process.
CO2-PO1 CO3-PO1 CO4-PO1	3 3 3	The statistical measures like mean, mode, median, standard deviation, skewness, coefficient of correlation and methodologies to fit a data using regression analysis and curve fitting is highly important while dealing with numerical information came out from practical implications.
CO5-PO1 CO6-PO1	3 3	Almost all the complex engineering problems and real world problems deals with either randomness or variability. As for randomness above listed statistical measures and methodologies are

		important, for problems involving variability mathematical formulation will involve differential and integral calculus as a part of it. And in most the cases numerical values are available from the experiments, which leads one to use numerical techniques to deal with such class of problems.
CO1-PO2 CO2-PO2 CO3-PO2 CO4-PO2 CO5-PO2 CO6-PO2	2 2 2 2 3 3	Formulation of the problem in mathematical form requires more attention and overall knowledge of complexity in depth. Knowing these listed methods in detail will help to map the problem in mathematical form and so one may easily outline the solution to the problem.
CO1-PO4 CO2-PO4 CO3-PO4 CO4-PO4 CO5-PO4 CO6-PO4	3 3 3 3 3 3	All these statistical or numerical methods are useful for analysis and interpretation of data. And by synthesizing the information using these methods one may reach to appropriate conclusions.
CO1-PO5 CO2-PO5 CO3-PO5 CO4-PO5 CO5-PO5 CO6-PO5	1 1 1 1 1 1	One may take help of IT seawares like MS Excel or SCILAB or MATLAB or programming languages like C or C++ etc. to design program and run it to avail optimal solution.
CO5-PO8	1	As all the numerical methods are based on algorithms, and need to strictly follow the same in order to avail optimal solution. This leads a mental exercise to follow the guidelines (like ethical principals or code of conduct by the concerned organization etc.).
CO3-PO10 CO5-PO10 CO6-PO10	1 1 1	Formulation of the problem is not just important, it is also important to infer the solution in form of application to real world or complex engineering problems. These methods again helps in that sense too.
CO1-PO12 CO2-PO12 CO3-PO12 CO4-PO12 CO5-PO12 CO6-PO12	1 1 1 1 1 1	Subject addresses the needs of lifelong learning and motivates students to updates his/her technical knowledge/skills.
CO1-PSO1 CO2-PSO1 CO3-PSO1 CO4-PSO1 CO5-PSO1 CO6-PSO1	1 1 2 2 1 1	Student will be able to deal with problems related to randomness or availing different central tendency or flow of the information or to design functional relationship between variable in their day to day life problem or in experimental results.
CO2-PSO2 CO3-PSO2 CO4-PSO2	2 2 3	When the numerical information related with structures is available, one may analyse its characteristics by use of central tendencies or other statistical measures.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

BUILDING& TOWN PLANNING

SUBJECT CODE: 2140607

B.E. 4th Semester

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Syllabus:

1	Introduction to buildings, Type of buildings, Principles of building planning, Principles of architecture composition
2	Building by–laws as per National Building Code, Standards for residential buildings, Building by–laws of local authority, standards for industrial, public, commercial and institutional buildings
3	Planning of earthquake resistant building considering symmetry, simplicity, continuity, consideration of locating staircase and overhead water tank, most sensitive to earthquake
4	Preparing working drawing of residential building, software application in planning, detached, semidetached, row houses and apartments with scale proportion, open spaces standard as per F.S.I. permissible
5	Elements of perspective views, Types of views such as one point, two point perspective etc. Building services like water supply, drainage, electrification etc. for modern buildings
6	Historical aspects and origin of Town Planning in the World and in India. Necessity of Civic surveys for Planning purpose, types, data and itspresentation and analysis, Fundamental principles of Town Planning
7	Land use Planning and percentage of different Land uses as per category of town. Components of town such as Zones, Road Network, CBD, Neighbour hood planning, Development controls for new town planning schemes for growth negotiation
8	Formation of Slums, Reasons of Slum formation, remedial measures for avoiding slum foundation. Introduction to smart city, its Characteristics as per present scenario.

Course Outcomes:

1. **Understand** local building bye-laws and provisions in National Building Code.
2. **Discuss** various aspects of principles of planning and architecture.
3. **Explain** the planning and design considerations to construct earthquake resistant building
4. **Prepare** working drawings, foundation plans and other executable drawings with proper details for residential buildings
5. **Planning** a city or town with all basic aminities / facilities.
6. **Design** low cost housing for slum management.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
C407.1	3	-	3	-	-	3	-	-	-	-	-	3	3			3	
C407.2	3			-	-	3	2	2	-	-	-	2	3		3		
C407.3	3	2	3	-	-	3	-	-	-	-	-	3	3			3	
C407.4	3	2	-	-	-	-	-	-	2	2	-		3			3	
C407.5	3	2	-	-	-	2	3	-		2	-	3	3		3	3	
C407.6	3	-		-	-	2	3	-		2	-	3	3		3	3	
C407	3	2	3			2.6	2.7	2	2	2		2.8	3		3	3	

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2140607.1-PO1	3	Basic knowledge of building bye laws necessary for any construction.
2140607.1–PO3	3	Design the buildings as per building code and bye laws.
2140607.1–PO6	3	Safety of the buildings and surrounding depends on proper planning.
2140607.1-PO12	3	Contionous learning new codes and bye laws.
2140607.2-PO1	3	Basic knowledge of principles of planning and architecture for any construction
2140607.2-PO6	3	Safety of the buildings and surrounding depends on proper planning.
2140607.2-PO7	2	Environmental safety is kept in mind while giving bye laws
2140607.2-PO8	2	The engineer and society is of utmost importance while designing of the building.
2140607.2 –PO12	2	Continous learning of various planning principles in better development of buildings.
2140607.3 -PO1	3	Basic knowledge of principles of planning and design considerations to construct earthquake resistant building
2140607.3 –PO2	2	plan the buildings as per building code and earthquake resistant building
2140607.3 -PO3	3	Design the buildings as per building code and earthquake resistant building
2140607.3 –PO6	3	Safety of the buildings and surrounding depends on proper planning.
2140607.3 -PO12	3	Continous knowledge of the latest design and improvement in design as per National Building Code.
2140607.4 -PO1	3	Basic knowledge of working drawings & foundation plans
2140607.4 –PO2	2	Design the buildings workings drawings and requirements.
2140607.4 –PO9	2	Team work for preparing and making models of temoporary works

2140607.4 –PO10	2	For renovating existing building the approval and communication between various people needed.
2140607.5 –PO1	3	Basic knowledge for planning smart city.
2140607.5 –PO2	2	Design the smart city with all amentities
2140607.5 –PO6	2	Safety of the buildings and surrounding depends on proper planning.
2140607.5 –PO7	3	Smart city helps I building a better environment and ecosystem with minimum usage of natural resources.
2140607.5 –PO10	2	For improving existing building the approval and communication between various people needed.
2140607.5 –PO12	3	Continous learning for improving the design with latest materials.
2140607.6 -PO1	3	Basic civil engineering knowledge for slum development.
2140607.6 –PO6	2	Safety of the buildings and surrounding depends on proper planning of slums and their removal in proper fashion.
2140607.6 –PO7	3	Environmental friendly and suistainable buildings.
2140607.6 -PO10	2	Improving the ill effects of the buildings various communationa nad seminars needed.
2140607.6 -PO12	3	Continous learning for improving the design of the green building and low cost building..
2140607.1 – PSO1	3	Students will be able to apply technical knowledge on local building bye-laws.
2140607.1 - PSO4	3	Students will be able to design functionally efficient structures using local building bye-laws
2140607.2 – PSO1	3	Students will be able to apply technical knowledge on various aspects of principles of planning
2140607.2 – PSO3	3	Students will deliver environmental friendly sustainable solutions using various aspects of principles of planning
2140607.3 – PSO1	3	Students will be able to apply technical knowledge for design considerations to construct earthquake resistant building
2140607.3 – PSO4	3	Students will be able to design functionally efficient structure for design considerations to construct earthquake resistant building
2140607.4 – PSO1	3	Students will be able to apply technical knowledge for preparations of working drawings, foundation plans
2140607.4 – PSO4	3	Students will be able to design functionally efficient structures using working drawings & foundation plans
2140607.5 – PSO1	3	Students will be able to apply technical knowledge for planning a smart city
2140607.5 – PSO3	3	Students will deliver environmental friendly sustainable solutions for a smart city
2140607.5 – PSO4	3	Students will be able to design functionally efficient structures for planning a smart city.
2140607.6 – PSO1	3	Students will be able to apply technical knowledge low cost housing for slum management
2140607.6 – PSO3	3	Students will deliver environmental friendly sustainable solutions low cost housing for slum management
2140607.6 – PSO4	3	Students will be able to design functionally efficient structures low cost housing for slum management

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

CONCRETE TECHNOLOGY

SUBJECT CODE: 2140608

B.E. 4th Semester

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Syllabus:

1	Introduction Introduction of concrete, Historic development, Composition of concrete, Advantages of concrete over other materials, Advances and future trends in concrete, Overview of Sustainability and Concrete development.
2	concrete Making Materials: 2.1 Cement: Chemical composition, Hydration of cement, structure of hydrated cement, Tests on cement (special cements, water chemical admixtures. 2.2 Aggregates: Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates. 2.3 Water – General requirements & limiting values of impurtities
3	Fresh Concrete: Properties of fresh concrete, Definition and Measurement methods of workability as per IS and ASTM standards, factors affecting workability, Segregation & Bleeding, Slump loss, Re-tempering, Site preparations for concreting, Mixing, Conveying, Placing, Compaction, Finishing of concrete. Curing & various methods of curing.
4	Hardened Concrete: Strengths of hardened concrete (Tensile & Compressive strength, Flexural & Bond strength), standard test methods as per IS and ASTM, Failure mechanism under compression & tension, Stress-strain behaviour of concrete, Overview of Modulus of elasticity, Dimensional stability –Creep & Shrinkage
5	Durability & Permeability of concrete: Causes of deterioration in concrete and durability problems, Factors affecting durability, Transport mechanism of gases & fluids in concrete, Cracking & causes of cracking, Carbonation induced & corrosion induced cracking, Alkali-aggregate reaction, Degradation by freeze & thaw, Sulphate attack, Durability under sea-water (marine environment).
6	Mix design of Concrete:

	Principles of concrete mix design, Parameters and factors influencing mix design, Indian Standard methods of mix design, Acceptability criteria, variability of results, Various provisions of IS code for sound concrete.
7	Special concrete and Concreting methods: advanced cement based composites, Fibre reinforced concrete, Polymer modified concrete, Self-compacting concrete, Light weight concrete, High strength concrete, Light-weight & heavy weight concrete, High volume fly ash concrete. Special concreting methods: Pumped concrete, Ready mix concrete, Under-water concreting, Hot & cold weather concreting, Precast concrete.
8	Miscellaneous Topics: Non-Destructive testing of concrete – Introduction to Destructive, semi-destructive & Non-destructive testing methodology, Problems faced during Non-destructive evaluation, Test methods like Rebound Hammer test, Ultra-sonic pulse velocity, Penetration tests, Pull out tests. Overview of Fracture Mechanics – Origin of fracture mechanics, Understanding the quassi-brittle nature of concrete, Failure of concrete under low stress, Micro—cracking, crack propagation, stress concentration at openings.

Reference Books:

1. Properties of Concrete - Neville A. M.

2. Concrete Microstructure, Properties and Materials –P.Kumar Mehta / Paulo J.M.Monteiro

3. Concrete Technology- Shetty M. S.

4. Advanced Concrete Technology – ZONGJIN Li

5. Concrete Technology- Gambhir M. L.

6. Concrete Technology by A.R. Santhakumar, IIT Madras

Course outcomes: After compelleting this course, the students wil be able to

1. **To list** various ingredients of the concrete and types of concrete , aggregates , cement and its applications.
2. **To compare** tests for quality control of concrete using IS specifications and properties of fresh and hard concrete.
3. **To Summarise** factors affectioning durability and permeability of concrete, causes of corrosion,cracking and carbonation.
4. **To discuss** about non-distructive tests of concretes.
5. **To design** mix by using various methods for concrete of desired strength.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2140608.1	3	1	-	1	-	1	1	-	-	-	1	1	3	-	-	-	1
2140608.2	3	-	2	-	1	-	-	-	1	-	-	1	2	-	-	1	-

2140608.3	3	-	-	2	1	-	1	-	-	-	-	1	2	-	-	1	-
2140608.4	1	2	2	-	1	1	-	-	-	-	-	1	1	-	--	1	1
2140608.5	2	-	3	1	-	-	1	1	1	-	-	-	1	3	-	-	1
2140608	2.4	1.5	2.33	1.33	1	1	1	1	1	-	1	1	1.8	3	-	1.25	1

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2140608.1- PO1	3	Basic knowledge of various ingradients and types of concrete, aggregate, cement will be gained by students.
2140608.1- PO2	1	Concepts of various ingradients of concrete and its applications will be useful to analyze various practical problems of engineering.
2140608.1- PO4	1	Students will benefited by information for experiments for various ingradients of concrete.
2140608.1- PO6	1	The contextul knowledge of various ingradients of concrete is useful in professional engineering practice.
2140608.1- PO7	1	The effect of utilization of various ingradients of concretes on environmental context is needed for sustainable development.
2140608.1- PO11	1	Students will understand the importance of ingradinets of concrete and its application for project management.
2140608.1- PO12	1	The basic knowledge of various types of concrete and its application is useful to correlate the current technological change.
2140608.2- PO1	3	The students will be able to know the procedure to conduct the test for ensure the quality control of concrete and learn about the properties of concrete.
2140608.2- PO3	2	The basic knowledge of quality and properties of concrete are useful for design solution at site.
2140608.2- PO5	1	Various morden tools and technics will be used to evaluate properties of concrete.
2140608.2- PO9	1	Students can be work to find out various properties of ingradients and concrete as a individual as well as in team.
2140608.2- PO12	1	Knowledge related to quality and properties of concrete is engage in independent and life long learning.
2140608.3- PO1	3	Students will be enrich by detail knowledge of properties of harden concrete.
2140608.3- PO4	2	Various laboratory experiments can be conducted to evaluate the durability and permeability of concrete.
2140608.3- PO5	1	Advance experimental technics will be used to find out the important properties of concrete like corrosion, cracking, carbonation.
2140608.3- PO7	1	The properties of harden concrete will be understand with respect to impact on environment.
2140608.3- PO12	1	The durability of the concrete have direct correlation with life span of structure which have broadest context with technological change.
2140608.4- PO1	1	Basic knowledge of non-destructive testing on concrete is essential to learn for the students.
2140608.4- PO2	2	The complex in-situ problem of concrete structure will be analyse by the principle of NDT.

2140608.4- PO3	2	The application of NDT for all damage building provide design based solution.
2140608.4- PO5	1	Selection and appropriate utilization of NDT tools for prediction of complex engineering problem will provide the solution.
2140608.4- PO6	1	The use of NDT will lead to the solution for certain technical and legal aspect of profession engineering practices.
2140608.4- PO12	1	NDT will be recognized as current need for technological change in the field of civil engineering.
2140608.5- PO1	2	The basic knowledge of concrete mix design using various methods is gained bt the students.
2140608.5- PO3	3	Concrte mix design will be useful for providing site specific design solution of concrete.
2140608.5- PO4	1	Students can learn the process of concrte mix design by conducting various experiments.
2140608.5- PO7	1	By utilizing various sustainable materials in concrete mix design have direct effect on environment.
2140608.5- PO8	1	The students will able to understand the ethical principal and professional responsibility at the time of performing concrete mix design.
2140608.5- PO9	1	Student will able to fuctionally effective and efficient to perform concrete mix design as per the requirement as a individual.

GUJARAT TECHNOLOGICAL UNIVERSITY
Civil Engineering
DESIGN ENGINEERING
5TH semester

Sr. No.	POs	Statement
1	PO207.1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	PO207.2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	PO207.3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	PO207.4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	PO207.5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	PO207.6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	PO207.7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	PO207.8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	PO207.9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	PO207.10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	PO207.11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	PO207.12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Sr. No.	COs	Statement
1	C207.1	Observe, Identify and define simple/ complex problems of day to day lives present in Industry/ Society.
2	C207.2	Apply knowledge of basic science and engineering fundamentals to demonstrate an in-depth technical competence.
3	C207.3	Integrate & summaries prior studies through various observations from various angles.
4	C207.4	Apply problem-solving methodologies to generate, evaluate and justify innovative solutions by designing and conducting experiments, analyzing and interpreting the data.
5	C207.5	Demonstrate the ability to execute designs with an ability to communicate effectively, making economical and multitasking solution.

Sr. No.	PSOs	Statement
1	PSO207.1	The students will be actively engaged in problem solving using Civil Engineering principles to address the evolving needs of the society.
2	PSO207.2	The students will be able to achieve expertise in design and analysis of various Civil Engineering structures.
3	PSO207.3	The students will be responsible technocrats in terms of ethics and value systems for socio-economic and environmentally sustainable development.
4	PSO207.4	The students will develop awareness for different codes of practice and bye laws to generate engineering designs which considers functionality, aesthetic, safety and cost effectiveness of civil Infrastructure.
5	PSO207.5	The students will have required knowledge, skills and attitude to choose and become an entrepreneur in Civil Engineering profession.

CO – PO & PSO Matrix

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
1	CO1	2		2	3	3	3	3		3	2	2	3	3	3	3	2	-
2	CO2	3	3	3	3	3	3	2	2	3	3	3	2	2	2	2	3	-
3	CO3	2	2	3	3	2	2	2	2	3	2	3	2	2	2	2	3	-
4	CO4	3	2		2	3	2	2		3	2	3	3	2	3	3	3	-
5	CO5	2		2		3	3	3	2	3	3	3	3	1	2	3	3	-
Avg. Mapi.		2.40	2.33	2.50	2.75	2.80	2.60	2.40	2.00	3.00	2.40	2.80	2.60	2.00	2.40	2.6	2.8	-

CO – PO Justifications

CO	PO	Value	Justifications
1	1	2	Basic knowledge is can be enhanced
1	2		
1	3	2	Student can apply knowledge for the solution of problem
1	4	3	Student can convert problem from complex to simple form
1	5	3	Student can apply direct approach
1	6	3	Student can serve society after this.
1	7	3	Student can serve society by protecting environment and looking to its sustainability.

1	8		
1	9	3	Students can learn how to work in teamwork for betterment.
1	10	2	Students can serve as a bridging gap through communicating how to apply knowledge for betterment.
1	11	2	Students can have idea about cost of the project and how to manage with existing resources.
1	12	3	Students cannot forget this topic for longer period of time.

CO	PO	Value	Justifications
2	1	3	student can apply basic knowledge
2	2	3	student can analyse the problem with basic science and engineering fundamentals
2	3	3	students can design the element
2	4	3	students can analyse or design the complex elements into simpler ones
2	5	3	students can check their problem via software also
2	6	3	student can design of the problem solution for betterment of society
2	7	2	Student can serve society by protecting environment and looking to its sustainability.
2	8	2	students can use their ethics in coordination with the rules given in IS codes
2	9	3	students can learn how to work in teamwork for betterment
2	10	3	students can communicate somewhat with designer
2	11	3	students can work on project scheduling and management with existing resources
2	12	2	Students cannot forget this topic for longer period of time.

CO	PO	Value	Justifications
3	1	2	student can apply basic knowledge
3	2	2	student can analyse the element
3	3	3	students can design the element
3	4	3	students can analyse or design the problem
3	5	2	students can check their problem via software also
3	6	2	students can have general idea about whole problem
3	7	2	some what environmental friendly
3	8	2	students have to follow rules given in IS codes for design
3	9	3	students can have general idea about whole structure
3	10	2	students can communicate some what with designer
3	11	3	students can have idea about cost of the structure.
3	12	2	Students can not forget this topic for longer period of time.

CO	PO	Value	Justifications
4	1	3	students can write complete report for design of problem identified
4	2	2	students can analyse the whole problem
4	3		
4	4	2	students can find the element to be modified in the project/ model for better functioning.
4	5	3	students can analyse and design whole problem definition via software.
4	6	2	Students can have total idea about the problem
4	7	2	students can work on sustainability of the project on environment
4	8		
4	9	3	Students can do analysis or design of project/ model individually also.
4	10	2	Student can communicate fully with designer also.
4	11	3	students can have total idea about cost and erection/ implementation of problem/

			model.
4	12	3	Students can not forget this topic for longer period of time.

CO	PO	Value	Justifications
5	1	2	student can apply basic knowledge of drawing
5	2		
5	3	2	students can understand design of problem/ model via drawing also.
5	4		
5	5	3	Students can generate drawings using software.
5	6	3	Students can interpret the whole design through drawings.
5	7	3	Students can analyze the practical importance of the project/ model to the environment
5	8	2	Students can check the drawings whether it was created as per IS rules or not.
5	9	3	Students can interpret the drawing of structure individually also.
5	10	3	Students can communicate in terms of technical data for the projects as a whole.
5	11	3	Students can handle the projects as a whole.
5	12	3	Students cannot forget this topic for longer period of time.

GUJARAT TECHNOLOGICAL UNIVERSITY

DISASTER MANAGEMENT
SUBJECT CODE: 2150003
B.E. 5th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
				ESE	PA (M)		ESE (V)		PA	
L	T	P	C	(E)	PA	ALA	ESE	OEP	(I)	
3	0	0	3	70	20	10	0	0	0	100

1	Understanding Disasters Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity–Disaster and Development, and disaster management
2	Types, Trends, Causes, Consequences and Control of Disaster Geological Disasters (earthquakes, landslides, tsunami, mining);Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves); Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Man-made Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters);Global Disaster Trends–Emerging Risks of Disasters–Climate Change and Urban Disasters
3	Disaster Management Cycle and Framework Disaster Management Cycle–Paradigm Shift in Disaster Management Pre-Disaster–Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster–Evacuation–Disaster Communication–Search and Rescue–Emergency Operation Centre–Incident Command System–Relief and Rehabilitation–Post–disaster–Damage and Needs Assessment, Restoration of Critical Infrastructure–Early Recovery–Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.
4	Disaster Management in India Disaster Profile of India –Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 –Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-Governmental Agencies
5	Aplications of Science and Technology for Disaster Management & Mitigation Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

Reference Books:

1 Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
6. Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2,Angus M. Gunn, Greenwood Press, 2008
7 Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur
8. Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages
9. Natural Disasters, David Alexander, Kluwer Academic London, 1999, 632 pages
10 Disaster Management Act 2005, Publisher by Govt. of India
11 Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
12 NIDM Publications
13 High Power Committee Report, 2001, J.C. Pant
14 Disaster Mitigation in Asia & Pacific, Asian Development Bank
15 National Disaster Management Policy, 2009, GoI
16 Disaster Preparedness Kit, American Red Cross
17 Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
18 Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
19 Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.
20 Roy, P.S. (2000): Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Indian Institute of Remote Sensing (NRSA) Dehradun.
21 Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster, APH Publishing Corporation, New Delhi.
22 Kasperson, J.X., R.E. Kasperson, and B.L. Turner III (Eds.), 1995, Regions at Risk: Comparisons of Threatened Environments, United Nations University Press, Tokyo
23 Singh Satendra (2003): Disaster Management in the Hills, Concept Publishing Company, New Delhi.
24 Taori, K (2005) Disaster Management through Panchayati Raj, Concept Publishing Company, New Delhi.

Course outcomes:

Students will be able to:

1. **Explain** disasters, disaster preparedness and mitigation measures.
2. **Classify** disasters and global disaster trends.
3. **Discuss** disaster management acts and guidelines along with role of various stack-holders during disasters.
4. **Illustrate** role of IT, remote sensing, GIS and GPS in risk reduction.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2150003.1	1	-	-	-	1	2	-	-	2	2	-	3	1	-	-	-	-
2150003.2	1	-	-	-	2	3	-	3	2	2	-	3	3	-	1	-	-
2150003.3	1	-	-	-	-	2	-	-	2	2	-	2	2	-	-	-	-
2150003.4	3	-	-	2	3	-	-	-	2	2	-	2	2	-	-	-	-
2150003	2	-	-	2	2	2	-	3	2	2	-	3	2	-	1	-	-

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2150003.1-PO1	1	Students will be able to understand and explain disasters, disaster preparedness and mitigations using fundamentals of science and engineering.
2150003.2- PO1	1	Using Engineering knowledge, students will be able to classify disasters and its global trends.
2150003.3- PO1	1	Disaster management acts and guidelines are properly understand by students using engineering fundamentals.
2150003.4- PO1	3	By using engineering knowledge, students will be able to illustrate role of information technology, remote sensing, GIS and GPS systems in risk reduction.
2150003.4- PO4	2	Students will be able to explain the use of various technologies and interpretation of data provided by them in risk reduction of disaster.
2150003.1-PO5	1	students will be able to understand use of modern tools or technologies, in disaster management preparedness and mitigations.
2150003.2- PO5	2	students will be able to find and explain the global trends of various disaster using modern technology.
2150003.4- PO5	3	Students will be able to illustrate the role of IT, GIS, GPS, remote sensing in risk reduction with the help of the knowledge of modern tools.
2150003.1-PO6	2	Students will be able to explain the disaster term and what are the responsibilities of the people to avoid or reduce the risk of disasters.
2150003.2- PO6	3	Students will be able to classify the disasters and global trends and understand the effects on people and role of the society to prevent it .
2150003.3- PO6	2	Students will be able to discuss disaster management acts and guidelines along with role of various stack-holders during disasters and understands the guidelines and role of various stack holder during disaster in context of society.
2150003.2- PO8	3	Students will be able to understand and discuss the disaster management acts and its guidelines and importance of the role of various stack holders and professional responsibilities of them.
2150003.1-PO9	2	Student will be able to prepare PowerPoint presentations on disaster

		related terms, preparedness and mitigation measures and present in classroom.
2150003.2- PO9	2	Students will be able to prepare PowerPoint presentations on classification of disasters and its globle trends and present it in class room.
2150003.3- PO9	2	Students will be able to prepare power point presentations on disaster management acts, guidelines and roles of various stake holders and present it in classroom.
2150003.4- PO9	2	Students will be able to prepare power point presentations on role of IT, remote sensing ,GIS and GPS systems in risk reduction of disasters and present it in classroom.
2150003.1-PO10	2	Students will be able to explain disaster, its preparedness mitigation measures using power point presentation.
2150003.2- PO10	2	Students will be able to Classify disasters and global disaster trends and explain them with details.
2150003.3- PO10	2	Students will be able to discuss disaster management acts and its guidelines and role of various stack holders in group.
2150003.4- PO10	2	Students will be able to Illustrate role of IT, remote sensing, GIS and GPS in risk reduction by preparing PowerPoint presentation and present them in class room.
2150003.1-PO12	3	Students will be understand disaster and its terms and its preparedness and mitigation measures that will help them recognize the need of disaster management.
2150003.2- PO12	3	Students will be classify disasters that will help them prepare to identify the situation and engage them with prior knowledge.
2150003.3- PO12	2	Students will be able to discuss disaster management acts and its guide lines and role of various stake holders which help them to act quickly and contact appropriate person in case of any disasters.
2150003.4- PO12	2	Students will be able to illustrate the role of IT, remote sensing, GIS and GPS system help them address the issue on hand in case of disaster as an engineer.
2150003.1-PSO1	1	By understanding the terms related to disasters ,its preparedness and mitigation measures students will be able to gain knowledge and use it in case of any disaster as an engineer.
2150003.2- PSO1	3	Classification of disasters and its global trends made students understand various disasters and causes of disaster which ultimately help them to deal with disastrous situations.
2150003.3- PSO1	2	Knowledge of disaster management acts, its guidelines and roles of various stake holders prepare students to act and contact appropriate authorities in case of a disaster.
2150003.4- PSO1	2	Awareness of use of Information technology, GIS and GPS system will help students to get information or relevant data needed to deal with any disaster as an engineer.
2150003.2- PSO3	1	Knowledge of various disasters, its causes and its global effects will help students to think about its preventive and mitigation measures and solutions while designing residential, industrial structures,

		transportation systems etc.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)
HIGHWAY ENGINEERING
SUBJECT CODE: 2150601
B.E. 5th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Scope of highway engineering, Highway planning and development in India, Classification of rural and urban roads, Road patterns, Planning and alignment surveys.	4	10
2	Highway geometric design: Cross sectional elements – width, surface, camber, Sight distances – SSD, OSD, ISD, HSD, Design of horizontal and vertical alignment – curves, super-elevation, widening, gradients, summit and valley curves	9	22
3	Highway materials: subgrade soil, aggregates, binder materials, bituminous materials, bituminous paving mixes, cement and cement	7	16

	concrete – their engineering and physical properties, basic tests.		
4	Pavement design factors, Design of flexible (GI and CBR method) and rigid pavements (fatigue concept), Construction of earthen, Gravel, WBM, Bituminous, Cement concrete, RCC and Pre-stressed concrete roads, Soil stabilized roads	**7**	**16**
5	Pavement failures, Maintenance, Surface and sub-surface drainage, Hill roads – alignment, construction, drainage and maintenance. Road side development – arboriculture, street lighting. Highway administration, economics and finance, road safety audit	**6**	**16**
6	Traffic engineering: basic elements, road users - vehicles - traffic flow characteristics, speed – volume studies, surveys, parking studies, Accident studies: causes, collision and condition diagrams, preventive measures, Traffic control: markings, signs, signals, intersections, rotaries.	**9**	**20**

Course Outcome:

(1) Discuss about highway planning and its classification
(2) Analyzing geometric design of highway
(3) Demonstrate the laboratory tests on aggregates and bituminous materials
(4) Analyzing preliminary design of flexible and rigid pavement
(5) Describe about pavement failures, its maintenance, importance of drainage, hill roads and their challenges
(6) Organize survey of classified traffic volume count and spot speed study on highway

Civil Engineering

Program Specific Outcomes:

1. The students will be actively engaged in problem solving using Civil Engineering principles to address the evolving needs of the society.
2. The students will be able to achieve expertise in design and analysis of various Civil Engineering structures.
3. The students will be responsible technocrats in terms of ethics and value systems for socio-economic and environmentally sustainable
   development.
4. The students will develop awareness for different codes of practice and bye laws to generate engineering designs which considers
   functionality, aesthetic, safety and cost effectiveness of civil Infrastructure.

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
2150601.1	3	2	-	2	-	-	2	-	-	-	2	-	2	2	2	2
2150601.2	3	3	3	2	2	-	2	-	-	-	-	-	2	2	-	2
2150601.3	3	3	3	2	2	-	-	-	-	-	-	2	-	3	-	-
2150601.4	3	3	3	2	3	-	-	-	-	-	2	-	2	2	-	2
2150601.5	3	3	-	2	2	-	2	-	-	-	-	-	-	2	2	2
2150601.6	3	3	3	2	2	-	-	-	2	-	-	-	2	2	-	-
2150601	3.0	2.85	3.0	2	2.33	3	2		2		2	2	2	2.16	2	2

Mapping & Justification

Mapping	Level	Justification
2150601.1-PO1	3	Knowledge about highway planning and its classification
2150601.1-PO2	2	Analysis of problems of highway planning .
2150601.1-PO4	2	Conduct investigations of complex problems about highway planning
2150601.1-PO7	2	With good highway planning the improvement of Environment and sustainability
2150601.1-PO11	2	Project management and finance is required for good highway planning
2150601.2-PO1	3	Knowledge about Analyzing geometric design of highway
2150601.2-PO2	3	Analyzing geometric design of highway
2150601.2-PO3	3	Carry out Geometric design of highway
2150601.2-PO4	2	Conduct investigations of complex problems geometric design of highway
2150601.2-PO5	2	Modern tool usage for geometric design of highway
2150601.2-PO7	2	With good geometric design of highway there will be improvement of Environment and sustainability
2150601.3-PO1	3	Knowledge about laboratory tests on aggregates and bituminous materials
2150601.3-PO2	3	Analysis of laboratory tests on aggregates and bituminous materials
2150601.3-PO3	3	Utilizing laboratory tests on aggregates and bituminous materials for designing
2150601.3-PO4	2	Conduct investigations of laboratory tests on aggregates and bituminous materials
2150601.3-PO5	2	Modern tool usage for laboratory tests on aggregates and bituminous materials
2150601.3-PO12	2	Usage of laboratory tests on aggregates and bituminous materials Life-long learning.
2150601.4-PO1	3	Knowledge about Analyzing preliminary design of flexible and rigid pavement
2150601.4-PO2	3	Analyzing solutions for preliminary design of flexible and rigid pavement
2150601.4-PO3	3	Analyzing preliminary design of flexible and rigid pavement
2150601.4-PO4	2	Conduct investigations for design of flexible and rigid pavement
2150601.4-PO5	3	Modern tool usage for design of flexible and rigid pavement

2150601.4-PO11	2	Project management and finance for design of flexible and rigid pavement
2150601.5-PO1	3	Knowledge about pavement failures, its maintenance, importance of drainage, hill roads and their challenges
2150601.5-PO2	3	Analyzing solutions for pavement failures, its maintenance, importance of drainage, hill roads and their challenges
2150601.5-PO4	2	Conduct investigations for pavement failures, its maintenance,
2150601.5-PO5	2	Modern tool usage for pavement maintenance,
2150601.5-PO7	2	With pavement maintenance, importance of drainage, will be improvement of Environment and sustainability
2150601.6-PO1	3	Knowledge about survey of classified traffic volume count and spot speed study on highway.
2150601.6-PO2	3	Analyzing solutions for survey of classified traffic volume count and spot speed study on highway.
2150601.6-PO3	3	Utilizing the data of survey of classified traffic volume count and spot speed study on highway for design of road network.
2150601.6-PO4	2	Conduct investigations for highway for design of road network.
2150601.6-PO5	2	Modern tool usage for survey of classified traffic volume count and spot speed study
2150601.6-PO9	2	Individual and team work conducting survey of classified traffic volume count and spot speed study

CO-PSO Mapping Justification

Mapping	Level	Justification
2150601.1-PSO1	2	Traffic Problem solving using highway planning
2150601.1-PSO2	2	Highway planning helps in design and analysis
2150601.1-PSO3	2	Highway planning helps in socio-economic and environmentally sustainable development.
2150601.1-PSO4	2	Highway planning considers functionality, aesthetic, safety and cost effectiveness .
2150601.2-PSO1	2	Traffic Problem solving using geometric design of highway
2150601.2-PSO2	2	Geometric design helps in design and analysis of highway
2150601.2-PSO4	2	Geometric design considers functionality, aesthetic, safety of highway
2150601.3-PSO2	3	Laboratory tests on aggregates and bituminous materials helps in design and analysis of highway
2150601.4-PSO1	2	Highway problem solving using design of flexible and rigid pavement
2150601.4-PSO2	2	Design and analysis of flexible and rigid pavement
2150601.4-PSO4	2	Design and analysis of flexible and rigid pavement considers functionality, aesthetic, safety and cost effectiveness of Highway
2150601.5-PSO2	2	Design and analysis of pavement failures
2150601.5-PSO3	2	Considering socio-economic and environmentally sustainable development pavement failures
2150601.5-PSO4	2	Ssafety and cost effectiveness of Highway pavement failures
2150601.6-PSO1	2	Highway problem solving using survey of classified traffic volume count and spot speed study on highway

2150601.6-PSO2	2	Survey of classified traffic volume count and spot speed study on highway helps in Design and analysis of Highway

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING
HYDROLOGY AND WATER RESOURCES ENGINEERING
SUBJECT CODE: 2150602
B.E. 5TH SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	MODULE – I Introduction, Hydrologic cycle, Climate and water availability, Water balances, Precipitation: Forms, Classification, Variability, Measurement, Data analysis, Evaporation and its measurement, Evapotranspiration and its measurement, Penman Monteith method. Infiltration: Factors affecting infiltration, Horton's equation and Green Ampt method.	8	20
2	MODULE – II Hyetograph and Hydrograph Analysis: Hyetograph, Runoff: drainage basin characteristics, Hydrograph concepts, assumptions and limitations of unit hydrograph, Derivation of unit hydrograph, S- hydrograph, Flow duration curve Groundwater: Occurrence, Darcy's law, Well hydraulics, Well losses, Yield, Pumping and recuperation test	10	20
3	MODULE – III Reservoir: Types, Investigations, Site selection, Zones of storage, Safe yield, Reservoir capacity, Reservoir sedimentation and control. Introduction to Dams	12	30

	Introduction and types of dams, spillways and ancillary works, Site assessment and selection of type of dam, Information about major dams and reservoirs of India Hydroelectric Power: Low, Medium and High head plants, Power house components, Hydel schemes.		
4	MODULE – IV Flood Management: Indian rivers and floods, Causes of floods, Alleviation, Leeves and floodwalls, Floodways, Channel improvement, Flood damage analysis. Hydrologic Analysis: Design flood, Flood estimation, Frequency analysis, Flood routing through reservoirs and open channels.	**8**	20
5	MODULE – V Drought Management and Water Harvesting: Definition of drought, Causes of drought, measures for water conservation and augmentation, drought contingency planning. Water harvesting: rainwater collection, small dams, runoff enhancement, runoff collection, ponds, tanks.	**4**	10

Reference Books:

1. K. Subramanya, Engineering Hydrology, Tata McGraw Hill Pub. Co. New Delhi.
2. C.S.P. Ojha, R, Berndtsson and P. Bhunya, Engineering Hydrology, Oxford University Press, New Delhi.
3. R.A. Wurbs and W.P. James, Water Resources Engineering, Prentice Hall of India, New Delhi.
4. R.K. Sharma and T.K. Sharma, Hydrology and Water Resources Engineering, Dhanpat Rai Publications, New Delhi.
5. R.K. Linsley, J.B. Franzini, D.L. Freyberg and G. Tchobanoglous, Water Resources Engineering, McGraw Hill Singapore.
6. V.P. Singh, Elementary Hydrology, Prentice Hall, Englewood Cliffs, New Jersey.
7. Ven Te Chow, D.R. Maidment and L.W Mays, Applied Hydrology, McGraw Hill International Edition, New York

Course Outcome:

1. **Define** occurrence movement and distribution of water
2. **Classify** diverse methods of collecting the hydrological information.
3. **Illustrate** water conservation methods to battle against drought
4. **Describe** dependable flow using flow duration curve and flow mass curve for the requirement of irrigation, power generation, Reservoir capacity,dams etc.
5. **Estimate** Design flood for the design of various Hydraulic Structures.

CO-PO mapping

	PROGRAM OUTCOMES (PO)												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
CO1	3	3	2	3	3	2	-	-	-	-	-	-	3	2	1	2	-
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	3	-	2	-
CO3	-	3	2	3	-	2	1	-	-	-	-	-	2	-	3	3	1
CO4	2	3	2	3	2	1	-	-	-	-	-	-	2	3	-	3	-
CO5	3	2	3	2	3	3	1	-	-	-	-	-	3	3	1	2	1

3: Strong 2: Moderate 1: Low -:NA

CO –PO Mapping & Justification

Mapping	Level	Justification
2150602.1-PO1	3	Students will be able to apply knowledge of science and engineering fundamentals in occurance and distribution of water in relation to water resources engineering.
2150602.1-PO2	3	Students can identify, review research literature regarding occurance and distrtibution of water.
2150602.1-PO3	2	Students will be able to give design solutions for complex ware resource problems by knowing science of hydrology.
2150602.1-PO4	3	Students can do analysis and interpretation of data by knowing occurance, movements and distribution of water in relation to water resources engineering.
2150602.1-PO5	3	Students will be able to select appropriate techniques and resources for distribution of water.
2150602.1-PO6	2	Students will be understand societal responsibilities regarding water resources field.
2150602.2-PO1	2	Students will be able to apply knowledge of mathematics, science and engineering fundamentals for collecting hydrological information.
2150602.2-PO2	3	Students can identify, formulate and review research literature regarding hydrological information.
2150602.2-PO3	3	based on knowledge of hydrological information, students can do design solutions for water resources problems.
2150602.2-PO4	1	On the basis of hydrological information, students can conduct investigations, experiments, analysis and interpretation of data for solving complex hydrological problems.
2150602.2-PO5	2	Students can apply their hydrological information knowledge in modern IT softwares for solving hydrological problems.
2150602.3-PO2	2	Students can formulate, can do research work after knowledge of water conservation methods against draught.
2150602.3-PO3	3	with knowledge of water conservation methods, students can develop solutions, system components with environmental considerations.
2150602.3-PO4	3	By knowing water conservation methods and knowledge of

		draught, students can do investigations on draught prone areas for water conservations.
2150602.3-PO6	2	With knowledge of Water conservation methods, future engineer students will be understand societal problems regarding water scarcity and apply engineering practises.
2150602.3-PO7	1	Students will be able for sustainable development regarding Environment regarding water conservation problems and solutions.
2150602.4-PO1	2	Students will be able to apply knowledge of mathematics, science, engineering fundamentals in relation to flow calculation for various hydraulic structures.
2150602.4-PO2	3	Students can do research work and identify the flow problems for dams, reservoirs spillways etc.
2150602.4-PO3	2	Students can do design of flow calculation and develop solutions for hydraulic structures.
2150602.4-PO4	3	Students can do investigations, experiments, interpretation of flow data for complex hydraulic structures based on knowledge of flow mass curve and flow duration curve.
2150602.4-PO5	2	Students will be able to use modern IT tools for computing flow mass curve and dependable flow for dams, reservoirs etc.
2150602.4-PO6	1	Knowledge of flow calculation for dams , reservoirs can be used for environment protection against flood and its impact on society.
2150602.5-PO1	3	Students will be able to apply engineering knowledge to estimate flood for complex hydraulic structures.
2150602.5-PO2	2	Students can do problems identification, review research literature and analyse flood problems.
2150602.5-PO3	3	Knowledge of flood estimation will help students to find or design solutions with appropriate consideration of public health with environmental considerations.
2150602.5-PO4	2	Students can conduct experiments on hydraulic structures models and interpret data in relation to flood prone areas.
2150602.5-PO5	3	With knowledge of flood estimation, students will be apply their knowledge on modern water resources software to find solution against flood.
2150602.5-PO6	3	Future civil engineer can understand the impact of flood on society and possible solutions against this type of natural disasters.
2150602.5-PO7	1	Students can understand the impact of flood on environment and try to develop sustainable environment against this type of natural disasters.

Program Specific Outcome (PSOs)

1. Graduates will be able to actively apply technical knowledge and skill for solving day to day civil engineering problems.
2. Graduates will be able to engage themselves to achieve expertise in design and analysis of structures by modern civil engineering tools.
3. Graduates will be able to become responsible technocrats to deliver environmental friendly sustainable solutions.
4. Graduates will be able to capable of design functionally efficient structures knowing the latest development in the field of civil engineering.
5. Graduates will be able to pursue their career as professional entrepreneur by using knowledge and soft skills.

CO-PSO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
CO1	3	3	2	3	3	2	-	-	-	-	-	-	3	2	1	2	-
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	3	-	2	-
CO3	-	3	2	3	-	2	1	-	-	-	-	-	2	-	3	3	1
CO4	2	3	2	3	2	1	-	-	-	-	-	-	2	3	-	3	-
CO5	3	2	3	2	3	3	1	-	-	-	-	-	3	3	1	2	1
CO																	

3: Strong 2: Moderate 1: Low -:NA

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

ENVIRONMENTAL ENGINEERING

SUBJECT CODE: 2150603

B.E. 5th SEMESTER

Type of course: Civil Engineering core subject

Prerequisite: The students should have studied the basics of Environmental Engineering

Rationale: The Civil engineer must be aware of the environmental effects of pollutants and should be able to understand the pollutants, their characteristics and manage systems to mitigate them.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Syllabus:

1	Introduction: Components of environment, Types of microbes, their growth and role in environment.
2	Quality and Quantity of Water for supply to towns/Cities: Sources of water, Assessment of domestic and industrial requirement, Impurities in water, Indian standards for drinking water, Water borne diseases and their control. The water (prevention and control of pollution) Act – 1974.
3	Characteristics of Wastewater: Physical, chemical and biological characteristics of domestic and industrial wastewaters. BOD and COD, study of characteristics of several industrial wastewaters like textile, chemical dairy and pharmaceutical wastewaters. Indian Standards for effluent to be disposed in receiving water body like rivers, estuaries, lakes, sea and oceans. Disposal of treated wastewaters (i) into inland surface waters; (ii) into oceans; (iii) into public sewers (iv) into estuaries and (v) onto land. Effect of organic pollution on Stream, river water quality, and self purification, DOSAG Curve.

4	House Drainage: Principles of house drainage, pipes and traps, Classification of traps: nahni trap, gulley trap, interception trap, grease trap, sanitary fitting, system of plumbing, house drainage plan for buildings.
5	Solid Waste Management: Quantity composition and characteristics of solid wastes. Classification of solid wastes. Hazardous solid wastes, Biomedical solid wastes, Typical generation rate for solid wastes, factors affecting the generation rate. Estimation of quantity of solid waste, Onsite handling, storage and processing, collection services, types of collection systems.Determination of vehicle and labor requirements, collection routes, transfer stations, location of transfer stations, transfer means and methods, solid waste processing techniques, Mechanical volume reduction, Thermal volume reduction, manual component separation. Ultimate disposal, land filling with solid waste, Design of landfills.
6	Air Pollution: Definition, Composition of atmospheric air, Classification and sources of air pollutants. Effects of air pollution on human, plant and material, Air pollution control methods, equipment and safety. Salient features of the Air (Prevention and control of pollution) Act – 1981.
7	Noise Pollution: Measurement of sound, Sources, Effects and control of noise pollution.
8	Introduction to: "The environment (Protection) Act – 1986.

Reference Books:

1. H.S. Peavy, D.R. Rowe and G. Tchbanoglous, Environmental Engineering, McGraw Hill International Edition.
2. M. L. Davis, Water and waste water Engineering, Mc Graw Hill education (India) Pvt. Ltd. 2013 edition.
3. A. P. Sincero and G.A. Sincero, Environmental Engineering, Prentice Hall of India, New Delhi.
4. G. Tchabanoglous, Solid Waste Treatment and Disposal, McGraw Hill Pub.
5. G.S. Birdie and J.S. Birdie, Water Supply and Sanitary Engineering, Dhanpat Rai
6. Publishing Co. New Delhi.
7. H.C. Parkins, Air Pollution, McGraw-Hill Pub.
8. J.A. Salvato, Environmental Sanitation, Wiley Interscience.
9. L.W. Canter, Environmental Impact Assessment, McGraw Hill Pub.
10. M.L. Davis and D.A. Cornwell, Introduction to Environmental Engineering,
11. McGraw Hill International edition.
12. 10. Metcalf and Eddy,(Revised by G. Tchobanoglous Wastewater Engineering:
13. Treatment, disposal Reuse, Tata-McGraw Hill, New Delhi.

Course Outcomes:

1. Understand the role of microorganisms in various components of environments
2. Explain the quality and characteristics of waste water
3. Design and prepare drainage plan of buildings
4. Describe solid waste management system
5. Discuss various environmental Acts.

6. Determine various resons for water/air / noise pollution.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2150603.1	3	3	-	2	2	2	3	1	-	2	-	2	3	1	2	2	-
2150603.2	3	2	3	3	2	-	1	-	-	1	-	2	3	2	2	1	1
2150603.3	2	2	3	3	3	-	3	-	2	-	1	2	2	1	1	3	3
2150603.4	3	3	3	2	2	2	3	2	2	-	3	2	3	3	3	2	1
2150603.5	-	2	-	-	-	3	3	3	-	-	-	2	3	1	3	-	-
2150603.6	3	3	2	-	3	2	2	2	2	3	-	3	3	2	2	-	-
2150603	3	2.4	-	1.7	2.5	-	-	-	1	2	-	2	4.2	2.5	3.7	2	1.2

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2150603.1-PO1	2	By Understanding the role of microorganisms in various components of environments will require application of chemistry, biochemistry, microbiology, so students will able to apply there engineering knowledge of different domain.
2150603.1-PO2	3	By Understanding the role of microorganisms in various components of environments Students will able judge different problem faced in treatment of water and waste water.
2150603.1-PO4	2	By understanding role of microorganisms student will able to conduct investigation design and analysis of complex problems.
2150603.1-PO5	2	By understanding role of microorganisms student will able to create , select and apply moden tools to control treatment process.
2150603.1-PO6	2	By understanding role of microorganisms studenrs will able to aware socity to for helth related problems cause by pathogenic microorganism.
2150603.1-PO8	1	By understanding role of microorganisms in treatment and concequenses of improper treatment ,students will take responsibility to awre society for helth problem causes by pathogenic microorganism.
2150603.1-PO10	2	By understanding role of microorganisms in treatment students will able to communicate helth isuues caused by improper treatment.
2150603.1-PO12	2	Basic concept of role of microorganisms in treatment will help to develop new solution and it will help in life long lerning.
2150603.2-PO1	3	Understand the quality and characteristics of waste water require application of physics , chemistry, biochemistry, microbiology, so students will able to apply there engineering knowledge of different domain.
2150603.2-PO2	2	By Understand the quality and characteristics of waste water students will able judge different problem faced in treatment waste water.
2150603.2-PO3	3	Understanding the quality and characteristics of waste water will

		help in proper design .
2150603.2-PO4	2	Understanding the quality and characteristics of waste includes analysis and interpretation of data, and synthesis of the information to provide valid conclusions
2150603.2-PO5	2	Students will able to apply moden tools and software realted to analysis of quality .
2150603.2-PO7	1	By Understanding the quality and characteristics of waste students can suggest engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
2150603.2-PO10	1	By Understanding the quality and characteristics of waste students will able to communicate helth isuues caused by improper treatment.
2150603.2-PO12	2	As the quality and quanty of waste water changes with,so basic quality of sewage will help to develop new design solution and it will help in life long lerning.
2150608.3-PO1	2	Design and preparation of drainage plan of buildings require application of fluid mechanics , building drawing , estimation, so students will able to apply there engineering knowledge of different domain. .
2150603.3-PO2	2	Proper Design and preparation of drainage plan of buildings require details analysis of problems.
2150603.3-PO3	2	Students will be able to carry out design of drainage system according to specified needs with appropriate consideration for the public health and safety
2150603.3-PO4	3	Design and preparation of drainage require experiments, analysis and interpretation of data, and synthesis of the information
2150603.3-PO5	3	Efficient Design of house drainage require use of morden IT tools, modeling,software etc
2150603.3-PO7	3	Water requirement of building is minimizd by Efficient Design of house drainage lead to sustainable development.
2150603.3-PO9	2	Efficient Design of house drainage require involve many displine so it is required to work as team for proper design .
2150603.3-PO11	1	Student will be able to handle project related to drainage design .
2150603.3-PO12	2	As water quality is changing day by day basic concept of design will help to develop new efficient design as per requirement of society and it will help in life long lerning.
2150603.4-PO1	3	Understanding and designing of solid waste management system require application of waste management , estimation, traffic survey , so students will able to apply there engineering knowledge of different domain.
2150603.4-PO2	3	Design of solid waste management system involves analysis of different complex problems related to collection conveyance and disposal of solid waste.
2150603.4-PO3	3	By lerning Design of solid waste management system students will able to provide proper solutution of problems related to solid waste
2150608.4-PO4	2	For effiecient design of solid waste management system require

		details investigation of sources , quantity , quality physical , chemical propertiesof waste, conveyance, disposal method etc
2150603.4-PO5	2	Efficient Design of solid waste management system require use of morden IT tools, modeling,software etc.
2150603.4-PO6	2	Design of solid waste management system reduce major airborne and water borne diseases that will help society for helthy life.
2150603.4-PO7	3	Efficient Design of solid waste management system will reduce waste generation as well as provide alternative use of waste material will help in sustainable development.
2150603.4-PO8	2	By understanding of solid waste management system students will understand responsibility of environment engineer towars socity.
2150603.4-PO9	2	All parts components of waste collection ,storage and disposal are interconnected so it is required to work as team for proper effient design .
2150603.4-PO11	3	For effiecient design of solid waste management system require details investigation of sources , quantity , quality physical , chemical propertiesof waste, conveyance, disposal method etc .By proper management of all component will reduse cost of whole project.
2150603.4-PO12	2	As the quality and quanty of solid changes with time ,so effiecient design of solid waste management system will help to develop new design solution and it will help in life long lerning.
2150603.5-PO2	2	By Understanding various environmental Acts. Students will able tpo anylis pollution related problem.
2150603.5-PO6	3	By Understanding various environmental Acts.students will able to awre socity about there environmental responsibility.
2150603.5-PO7	3	By Understanding various environmental Acts will help to create in sustaintable environment.
2150603.5-PO8	3	Undestanding of Environmental act will create responsibily in people to maintain clean environment.
2150603.5-PO12	2	Environmental acts are changing with quality of pollution so it help students in life long lerning.
2150603.6-PO1	3	In Performance of common environmental experiments students will apply engineering knowledge of different subjects like physics , chemistry, biochemistry, microbiology etc
2150603.6-PO2	3	By knowing quality of water and waste water students will able to know problems caused by it.
2150603.6-PO3	2	Quality of water and waste water help to design different treatment unit.
2150603.6-PO5	3	Students will able to lern Different modern tool used in laboratory performance.
2150603.6-PO6	2	By knowing quality of water and waste water studenrs will able to awrew socity to for helth related problems.
2150603.6-PO7	2	By Understanding quality of water and waste water students can suggest engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
2150603.6-PO8	2	By Understanding quality of water and waste water students will

		understand responsibility of environmentntal engineer towards socity.
2150603.6-PO9	2	Determination of quantity of water and waste water involve many displine so it is required to work as team for proper results .
2150603.6-PO10	3	By undstanding quantity of water and waste students will able to communicate helth isuues caused by improper treatment.
2150603.6-PO12	3	As the quality and quanty of water water changes with time which leads to change in design of treatment components ,so basic concept of treatment will help to develop new design solution and it will help in life long lerning.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

STRUCTURAL ANALYSIS-II

SUBJECT CODE: 2150608

B.E. 5thSEMESTER

Teaching scheme and Examination Scheme:

Teaching Scheme			Credits	Examination marks						Total marks
				Theory marks			Practical marks			
L	T	P	C	ESE(E)	PA(M)		ESE(V)		PA(I)	
					PA	ALA	ESE	OEP		
4	2	0	6	70	20	10	30	0	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Weightage %
1	**Energy Principles:** Castigliano's theorems , computation of displacements of statically determinate beams, trusses and frames by unit load method, analysis of indeterminate structures – beams, trusses, frames	10	15
2	**Slope Deflection Method** Analysis of continuous beams for various loading including settlement/ rotation of support, analysis of simple portal frame with sway.	08	15
3	**Moment Distribution Method** Analysis of continuous beams & frames including sway, use of symmetry of structure up to two storeyed / two bay frames.	08	15
4	**Influence line diagrams** ILD for statically determinate beams- I.L.D of support reaction, shear force and moment bending moment for beams subjected to u.d.l and several point loads, criteria for maximum effects, ILD for statically determinate trusses, forces in members for u.d.l and point loads	08	15
	ILD for statically indeterminate beams: Muller-Breslau's principle, steps for obtaining I.L for reaction and internal forces in propped cantilever and continuous beams, qualitative I.L for rigid jointed structures having higher degree of statically indeterminacy.	06	10
5	**Matrix Methods:** Types of skeletal structures, Internal forces and deformations. Introduction and applications of stiffness method to analyze beams, Trusses and plane frames by system approach.	08	15
	Introduction and applications of Flexibility method to analyze beams, Trusses and plane frames by system approach.	08	15

Reference Books:

1. Junarkar S. B. & Shah H. J.; Mechanics of Structures Vol-II; Charotar publishing house,Anand
2. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, NewDelhi
3. Gere & Weaver; Matrix Analysis of framed structures, CBS Publications
4. Ryder G.H.; Strength of Materials; Mcmillan
5. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi
6. Hibbler R C; Structural Analysis; Pearson Education

Course Outcomes:

After completing this course, students will be able to:

1. **State** various methods used to analyse determinate and indeterminate structures.
2. **Apply** equilibrium and compatibility equations to determine response of statically determinate and indeterminate structures.
3. **Select** suitable method to find displacements and internal forces of statically indeterminate structures.
4. **Prepare** influence line diagrams for determinate and indeterminate structures to determine reactions and internal forces when subjected to moving loads.

PSOs-Program Specific Outcomes

PSO 1. Educating students with fundamental and technical knowledge for actively apply to solve day-to-day societal problems related to the field of civil engineering.

PSO 2. Motivate to engage them for achieving expertise in design and analysis of structures by modern civil engineering tools.

PSO 3. Cultivate skills for continuous learning to achieve functionally efficient, cost effective and safe solutions of modern infrastructure development.

PSO 4. Inculcate students to develop professional skills, abilities and attitude for wage employment and/or to become entrepreneur.

PSO 5. Inspiring Students to become ethically responsible technocrats to deliver environmental friendly and sustainable solutions

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2150608.1	3	2	-	1	-	-	-	-	1	2	-	-	3	2	-	2	-
2150608.2	3	3	-	2	2	-	-	-	-	-	-	-	2	2	-	-	-
2150608.3	3	2	-	2	-	-	-	-	-	-	-	-	3	3	-	-	-
2150608.4	3	2	-	2	-	-	-	-	-	-	-	-	2	2	-	1	-
2151608	3	2	-	2	2	-	-	-	1	2	-	-	3	2	-	2	-

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2150608.1-PO1	3	Basic knowledge of various methods to analyze determinate and indeterminate structures will be gain by students.
2150608.1-PO2	2	Concepts learned in this subject will be useful to analyze problems in design of different structural members.
2150608.1-PO4	2	This course will help to understand student's complex problem's analysis.
2150608.1-PO9	1	Students will be able to prepare PowerPoint presentations individually for various methods.
2150608.1-PO10	2	Students will prepare power point presentation on various methods and principles for the analysis of structures and present it.
2150608.2-PO1	3	Students will be able to apply knowledge of subject for to find the response of the structures.
2150608.2-PO2	2	Students will be able to formulate equilibrium equations and compatibility conditions for the given problem.
2150608.2-PO4	2	Students will be able to conduct investigation of complex problem.
2150608.2-PO5	2	Students will be able to use calculators and other software tools to solve the equations.
2150608.3-PO1	3	Student will be able to find displacement for the structures using concepts of the subject.
2150608.3-PO2	2	Students will be able to find displacements for the beam, frame and truss and internal member forces for the truss.
2150608.3-PO4	2	Students will be able to able to interoperate data and choose suitable method for the complex problem.
2150608.4-PO1	3	Apply knowledge about influence line to find unknowns in the analysis of beams for different loadings.
2150608.4-PO2	2	Conceptual knowledge about influence line will be applied for the beam subjected to moving loads.
2150608.4-PO4	3	Concepts of Influence diagram is used for the specific loading conditions to get the maximum values of S.F and B.M for the complex problems.
2150608.1-PSO1	3	Various methods used for analysis will be helpful to the students to analyze the actual field conditions of the structure.
2150608.2-PSO1	2	Students will be able to analyze the determinate and indeterminate structures with the application of equilibrium and compatibility equations.
2150608.3-PSO1	3	Selection and application of suitable method to find displacement and internal forces students will be able to use this knowledge in field practice.
2150608.4-PSO1	2	Preparation of influence line diagram for determinate and indeterminate structures for the moving load will help student in solving complex problems.
2150608.1-PSO2	2	Learning of various methods of analysis and application of them will help student to get expertise in design and analysis of
2150608.2-PSO2	2	

2150608.3-PSO2	3	structures using modern tools.
2150608.4-PSO2	2	
2150608.1-PSO4	2	Student will be able to analyze the actual structures using various methods and they are able use profession software's for the analysis.
2150608.4-PSO4	1	

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING
SOIL MECHANICS
SUBJECT CODE: 2150609
B.E. 5thSEMESTER

Syllabus:

1	Compaction: Definition, Theory of compaction, Factors affecting compaction, Laboratory compaction tests, Effect of compaction on soil properties, Placement water content, Placement layer thickness, Field control of compaction, Proctor's needle, Methods of compaction used in field.
2	Shear Strength of Soil : Mohr's strength theory, Mohr- coulomb's strength theory, Modified Mohr coulomb's theory, Shear parameters tests: Direct shear test, Unconfined compression test, lab. Vane shear test, Triaxial compression test, Shear tests based on drainage conditions.
3	Consolidation of Soils : Compressibility of soils, Definitions and mechanism of consolidation, Spring analogy, Void ratio and effective stress relation, Related indices, Assumptions of Tarzagi's one dimensional consolidation theory, Time factor, One dimensional consolidation tests, Laboratory and theoretical time curves, Determination of pre-consolidation pressure, Estimation of consolidation settlement and rate of settlement for uniform pressure increment in a clay layer
4	Stability of Slopes: Infinite and finite slopes, factor of safety, type of slope failure, stability of infinite slopes, finite slopes, forms of slip surfaces, limit equilibrium method and critical stage instability analysis, effects of tension crack and submergence, C-analysis-method of slices, taylor's stability no., Bishop's method.
5	Earth Pressure Types of lateral earth pressure, Rankine's and Coulomb's earth pressure, Theory and their application for determination of lateral earth pressure under different conditions,Rebhann's and Culmann's Graphical methods of determination of lateral earth pressures
6	Stress Distribution of Soils: Causes of stress in soil, geostatic stress,Boussinesque's equation, stress distribution diagrams, New-mark's influence chart Westergard's equation, contact pressure, stresses due to triangular and circular, strip and rectangular loadings.
7	Basics of foundation: Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation

Reference Books:

1) P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson
2) Education.
3) B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd.,
4) Delhi.
5) Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers &
6) Distributors, Delhi
7) Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
8) V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical
9) Consultants, Banglore
10) Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.
11) Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
12) Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.

Course outcomes:

After completing this course, the student's will be able to:

1. **Explain** various geotechnical properties of soil, through various methodology and application for foundation systems for various civil engineering structures.
2. **Prepare** various topics like compaction, shear strength, consolidation, earth pressure, stress distribution and soil parameters based on need of project site.
3. **Distinguish** soil testing procedures, experimentation techniques and related issues about mechanics on soil as a material, its behavior before failure.
4. **Evaluate** details of foundations, its selection procedures as per soil conditions and various modifications available for various degrees of loads.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2150609.1	3	2	1		-	-	-	-	2	1	-	2	2	1		-	1
2150609.2	3	2	2	2	-	-	-	-	1	1	-	1	2	2		1	1
2150609.3	3	3	3	2	-	-	-	-	-	-	-	1	2	2		1	1
2150609.4	3	2	1	2	-	-	-	-	-	-	-	-	3	1		2	1
2150609	3	2	2	2	-	-	-	-	2	1	-	1	2	2		1	1

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2150609.1-PO1	3	Basic knowledge of principles of soil testing methods will be gained by students.
2150609.1-PO2	2	Wii be useful to identify and analyze various practical problems of soil engineering.
2150609.1-PO3	1	Can prepare complete soil profile which will be helpful in design solution.
2150609.1-PO9	2	Testing practices and report preparation will provide students, a good team spirit.
2150609.1-PO10	1	Communication skill will be developed during report presentation.
2150609.1-PO12	2	Students will use the knowledge of analytical result for development of solution.
2150609.2-PO1	3	Knowledge of geotechnical properties is essential for analysis of various soil strata.
2150609.2-PO2	2	Selection of Testing methodology will be identified for analysis of specific foundation problem.
2150609.2-PO3	2	Students will be able to analyze the foundation system related to loading for structure under consideration.
2150609.2-PO4	2	Students will be able to interpret the results to provide conclusion
2150609.2-PO9	1	Students will be capable of identify the important concept of strain energy stored in a body.
2150609.2-PO10	1	From the knowledge of soil characteristics students will be able to write report effectively.
2150609.2-PO12	1	Students will gained the sound knowledge and better understanding of foundation design.
2150609.3- PO1	3	Learning of various soil parameters is useful for for classification of soil mass.
2150609.3-PO2	3	Students will be able to classify soil mass through experimental results.
2150609.3-PO3	3	Students can choose and design proper foundation system under different soil conditions.
2150609.3-PO4	2	An understanding of soil properties is essential for interpretation of the data
2150609.3-PO12	1	Lifelong stability of the structure will be achieved.
2150609.4- PO1	3	Selection and type of foundation system will be identified for various structures.
2150609.4-PO2	2	Will be able to calculate load carrying capacity of the structures.
2150609.4-PO3	1	Fairly accurate assessment of foundation will be done.

2150609.4-PO4	2	Will be able to suggest soil improvement techniques.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)

ADVANCED CONSTRUCTION AND EQUIPMENTS

SUBJECT CODE: 2160601

B.E. 6th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

SYLLABUS:

Sr. No.	Contents	Total Hrs.	% Weightage
1	**Module - 1** **Pile Foundations:** Introduction, uses, selection of pile, types of piles, pile cap and pile shoe, pile driving methods, micro piling, causes of failures of piles, Heaving of piles **Caissons**: Definition, uses, construction material, types of caissons, loads on caisson, design features of caissons, floating of caissons, cutting edges, sinking of caisson, tilting of caisson, shifting of caisson, caisson diseases	**4** **4**	**20**
2	**Module - 2** **Diaphragm wall construction:** Introduction, uses, site selection criteria **Coffer Dams:** Definition, uses, selection of coffer dams, types of coffer dams, design features of coffer dams, leakage prevention, economic height **Control of Ground water in Excavations:** Methods-pumping, well points, bore wells, electro-osmosis, injections with cement, clays and chemical, freezing process, vibro- flotation.	**1** **2** **2**	**10**
3	**Module - 3** **Form work:** Form work for R.C.C. Wall, slab, beam and column, centering for arches of large spans and dams, design features for temporary works, slip formwork, False work for Bridges **Construction of tall structures:** Materials of tall structures. Structural system for tall structures.Methods of construction of tall structures. **Demolition of Structure:** Demolition, taking down, dismantling, methods, safety	**4** **3** **1**	**20**
4	**Module - 4** **Construction Equipment :** 1. Mechanization in Construction: Importance of construction equipments their classification, selection and contribution rate of production (Output), Owning and operating cost.	**2**	**10**

	2. Engineering fundamentals : Related to performance of IC engines, rimpull, drawbar pull, Coefficient of traction,Gradability.	**3**	
5	**Module - 5** **Excavating equipments :** Selection, basic parts, operation, factors affecting output Tractors and related equipment: Bulldozers, Rippers, Scrapers **Excavating Equipment:** Power shovels, Draglines, Hoes, Clam shells and trenching machines.	**8**	**20**
6	**Module - 6** **Hauling and conveying equipments :** Belt conveyor system : Terminology, Classification, Components, Power requirement estimation and design. **Hauling and lifting equipment:** Trucks, wagons, cranes etc., Pile boring / driving equipment, Concrete Batching plant, Tunnel Boring machines, Crushers, Air compressors, Drilling and blasting equipments	**8**	**20**

Reference Books:

1. Building Construction by B.C.Punamia
2. Building Construction by S.C.Rangwala
3. Building Construction by Gurucharan Singh
4. Heavy Construction by Vazirani & Chandola
5. Construction, Planning, Equipment and Methods by R.L.Peurifoy
6. Building Construction By Dr. Jha & S.K. Sinha
7. Hand book of Heavy construction: O'Brien, Havers & Stubb
8. Construction Engineering and Management By S.Seetharaman
9. Construction Equipment and Its Management By S C Sharma
10. Construction Equipment By Jagdish Lal
11. Construction equipment and its planning and application By Mahesh Verma Metropolitan Book Co.

COURSE OUTCOMES:

After completing the course, the students will be able to:

2160601.1 **Explain** advance construction techniques of pile foundation and caisson.
2160601.2 **Describe** the metods of controlling ground water in excavations and types of coffer dams.
2160601.3 **Apply** suitable type of form work and principles of demolition of a structure,
2160601.4 **Select** appropriate construction equipments for desired construction works.
2160601.5 **Understand** the working principle and use of various equipments to be used for heavy Civil Engineering structures.

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES												PSOs				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**
2160601.1	3	-	-	2	3	-	-	-	-	-	-	2	3	-	-	-	2
2160601.2	3	3	-	2	2	-	-	-	-	-	-	1	3	-	1	-	1
2160601.3	2	-	-	2	2	2	2	-	-	-	-	-	2	-	2	1	-
2160601.4	3	1	-	-	3	-	-	-	-	-	1	2	3	-	-	-	2
2160601.5	2	2	2	-	2	-	-	-	-	-	-	-	2	-	-	-	-
2160601	**2.6**	**2**	**2**	**2**	**2.4**	**2**	**2**	**-**	**-**	**-**	**1**	**1.67**	**2.6**	**-**	**1.5**	**1**	**1.67**

3: Strong 2: Moderate 1: Low -:NA

CO-PO MAPPING & JUSTIFICATION:

Mapping	Level	Justification
2160601.1-PO1	3	Aquire the basic knowledge of advanced construction methods for deep foundation of pile and casisson, its classification, construction procedures and selection criteria.
2160601.1-PO4	2	Conduct the Investigation of complex problems occurred during the execution of works.
2160601.1- PO5	3	Select the appropriate techniques and tools for the execution.
2160601.1-PO12	2	Based on the experience for similar problems occurred and their solution, it can be used for solution generation for future work.
2160601.2-PO1	3	During deep excavations, ground water control is predominant problem faced by civil engineers; it can be better understood for efficient execution of deep foundation especially in water logged or water body areas to construct suitable types of coffer dams.
2160601.2-PO2	3	Students use various latest open source tools and frameworks for performing their laboratory experiments. So, they will be acquainted with latest tools and techniques.
2160601.2-PO4	2	Conduct the investigations to control ground water in excavations and for selection of suitable type of coffer dam.
2160601.2 -PO5	2	For coffer dam and ground water controlling method, selection and application of modern tool and its use is important factor.
2160601.2-PO12	1	By involvement of such work, they can be recognize the need and ability to execute the task.
2160601.3-PO1	2	Basic knowledge of importance, requirements, and types of form work is necessary and also the need for demolition of any existing structure is to be work out.
2160601.3-PO4	2	Any defect or improper selection of form work or method of demolition will result in several severe technical and other problems causing degradation of building, so proper investigation is required while selecting such techniques or form work.
2160601.3-PO5	2	Selection and application of modern trends, tools, techniques are important in complex or unique projects.

2160601.3-PO6	2	Adopt a suitable method of demolition is of prime requirement which cause adverse affect on society, health and safety.
2160601.3-PO7	2	Unique projects required for sustainable development, which can be best fitted with the help of appropriate selection of form work or advanced engineering methods.
2160601.4 -PO1	3	Basic knowledge of the equipments is required to select the appropriate equipments to achieve desired construction work.
2160601.4-PO2	1	Identifying the problem in selection of equipment is also important in the case of break down or non functional of them.
2160601.4 –PO5	3	Select and use the modern tool required for heavy civil engineering construction work.
2160601.4 -PO11	1	Basic of project management and finance is also required while working with equipments and tool which may affect the economy of the project.
2160601.4 -PO12	2	Appropriate selection of construction equipment have potential use in the industry which leads to develop the ability of an engineer.
2160601.5- PO1	2	Apply the knowledge of engineering fundamentals to solve civil engineering problems by understanding the working principle and use of various equipments.
2160601.5- PO2	2	Identify the appropriate type of equipment after formulating the problem to be occurred during the execution of the work.
2160601.5- PO3	2	Based on the problems of past experiences and likely to be occurred, they can develop the general solutions with appropriate consideration for the public health and safety.
2160601.5- PO5	2	Use of various modern civil engineering equipments are of much significane to expedit the project with advancement techniques.

CO-PSO MAPPING & JUSTIFICATION

Mapping	Level	Justification
2160601.1-PSO1	3	Students can apply technical knowledge and skill of pile foundation and caisson to solve the civil engineering problems.
2160601.1-PSO5	2	Graduates can pursue their career as professional engineer by using knowledge and skills of various methods of deep excavations in very big civi engineering projects.
2160601.2-PSO1	3	Using various methods of ground water control in specific conditions and suitable type of coffer dam is an essential need to apply technical knowledge and skill.
2160601.2-PSO3	1	While dealing with subsurface investigations, it should be environmental friendly sustaible method adoption.
2160601.2-PSO5	1	Students can develop career for resolving ground water problem in deep excavations and also in the field of coffer dam construction for bridge foundations construction or cassion.
2160601.3-PSO1	2	Basic knowledge of suitable type of form work and demolition of structure is an essential to solve the problems.
2160601.3-PSO3	2	Working with demolition of structure and form work, it should be in technocrate to deliver eco-friendly solutions.

2160601.3-PSO4	1	Students can start the career for labour or material contractor to supply various advanced form work or cast special form work desing for special type of structures.
2160601.4-PSO1	3	Basic knowledge of construction equipments are required to solve the on site problems occurred during the operation of machines.
2160601.4-PSO5	2	Students can also develop career for supplying the such advanced civil engineering related equipments and manage the work with equipments.
2160601.5-PSO1	2	Understand the basic working priniciple and use of various equipments are necessary to solve the minor repair and maintenance on the site work execution to avoid any hazardous condition working with machineries and equipments.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)
APPLIED FLUID MECHANICS
SUBJECT CODE: 2160602
B.E. 6th SEMESTER

Prerequisite: Fluid Mechanics

Rationale: To develop basic understanding for solving field problems related to fluid flow through pipes, open channels, turbo-machines and perform model analysis.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Contents

Sr No	Contents	Teaching hrs	Weightage %
1	**Module I** **Flow Through Pipes:**Introduction-Continuity equation-Energy equation-Momentum equation-Major and minor energy losses, hydraulic gradient and total energy line-pipes in series and parallel-pipe networks- hydraulic transmission of power. Navier-Stokes equation of motion- Initial conditions and boundary conditions. Viscous flow-Couette flow, Hagen-Poiseuille equation-flow between parallel plates. Turbulent flow in pipes-Prandtl's mixing length theory- velocity distribution- Smooth and rough boundaries-water hammer phenomenon	12	30
2	**Module II** **Boundary Layer**: Boundary layer concept-laminar and turbulent boundary layer growth over a flat plate, Von-Karman momentum integral equation- Separation of boundary layer and wake formation.	4	10
3	**Module III** **Open Channel Flow**: Basic concept of open channel flow- Steady uniform flow-Velocity distribution-Optimum shape of cross section for uniform flow- Energy equation-specific energy-specific energy diagram-discharge diagram-Application of specific energy and discharge diagrams. Non-Uniform steady flow-equations for gradually varied flow- Direct Step method, Rapidly varied flow- Hydraulic jump- Location of hydraulic jump- flow under sluices-Water surface profiles.	11	30
4	**Module IV** **Turbo Machinery**:Water Turbines: Impulse turbine-Reaction turbine-	9	20

	Specific speed-Unit quantities, Performance characteristics for water turbines,Centrifugal pumps: Pumps in series and parallel, Specific speed, Unit quantities, and characteristics curves, Cavitation in turbines and pumps. Introduction to Ventilation System.		
5	**Module V** **Dimensional Analysis and Similitude**: Fundamental dimensions-Physical Quantity and Dimensions-Dimensional Homogeneity- Non Dimensional parameters, π-Theorem dimensional analysis, Choice of variables, Determination of Dimensionless parameters. Model Similitude-Physical models- geometric-kinematic and dynamic similarity, Model studies.	6	10

Reference Books:

1. Theory and Applications of Fluid Mechanics by K Subramanya, McGraw Hill Publication
2. Fluid Mechanics by A.K. Jain, Khanna Publishers, New Delhi
3. Hydraulics and Fluid Mechanics by P.N. Modi and S.M. Seth, Standard Book House, New Delhi
4. Fluid Mechanics by Victor L. Streeter, E. B. Wylie by, McGraw Hill Publication
5. Fluid Mechanics by Frank M White , McGraw Hill Publication

Course Outcomes:

After successful completion of the course the students shall be able to:

1. **Categorize** fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions
2. **Comprehend** , **illustrate** and **study** the performance characteristics of hydraulic machines
3. **Design** optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle.
4. **Analyze** and **design** streamlined objects considering boundary layer effects.
5. **demonstrate** model studies for fluid flow problems

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
C602.1	2	-	3	2	1	-	-	-	-	-	-	-	2	3	-	1	2
C602.2	2	3	3	1	2	-	-	-	-	-	-	-	3	3	1	-	-
C602.3	2	3	3	2	1	-	-	-	-	-	-	-	2	3	-	2	-
C602.4	-	1	2	2	1	-	-	-	-	-	-	-	2	3	-	2	2
C602.5	1	3	2	2	-	-	-	-	-	-	-	-	3	2	-	2	1
C602																	

3: Strong 2: Moderate 1: Low -:NA

CO –PO Mapping & Justification

Mapping	Level	Justification
2160602.1-PO1	2	With knowledge of fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions, graduates will beable to apply mathematics, science, and engineering fundamental to determine discharge, headloss, velocity , pressure etc.
2160602.1-PO3	3	With knowledge of fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions, graduates will be

		able to find design solution for complex pipe specifications.
2160602.1-PO4	2	With knowledge of fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions, graduates will be able to conduct experiments, analysis and interpretation of complex pipe networks.
2160602.1-PO5	1	With knowledge of fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions, graduates will be able to use modern IT Tools to solve complex pipe networks.
2160602.2-PO1	2	By Comprehend , illustrate and study the performance characteristics of hydraulic machines, graduates will be able to apply science, mathamatics and engineering fundamentals to solve haydraulic machines problems.
2160602.2-PO2	3	By Comprehend , illustrate and study the performance characteristics of hydraulic machines, graduates can identify, formulate and analyze complex problems related to hydraulic machines.
2160602.2-PO3	3	By Comprehend , illustrate and study the performance characteristics of hydraulic machines, graduates can make design solutions for hydraulic machines having environmental considerations.
2160602.2-PO4	1	By Comprehend , illustrate and study the performance characteristics of hydraulic machines, graduates will be able to make experiments, analysis and interpretation of data on performance of hydraulic machines to increase their efficiency.
2160602.2-PO5	2	By Comprehend , illustrate and study the performance characteristics of hydraulic machines, graduates can use modern IT tools or softwares to observe overall performance characteristics of hydraulic machines.
2160602.3-PO1	2	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle., graduates will be able to solve complex open channel flow problems using science and engineering fundamentals.
2160602.3-PO2	3	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle, graduates will identify , analyze and review research literature related to open channel flow problems.
2160602.3-PO3	3	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle, graduates will be able to design hydraulic structures consideration with opan channel flow.
2160602.3-PO4	2	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle, gradutes will be able to conduct investigations by doing some experiments on open channel flow model of real life problems.
2160602.3-PO5	1	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle, graduates can use modern IT Tools or softwares for design of open channel and problems realted to open channel flow.
2160602.4-PO2	1	By analizing and design of streamlined objects considering boundary layer effects, graduates will be able to analyze boundry layer problems realted to airodynamics and heat and mass transfer.
2160602.4-PO3	2	By analizing and design of streamlined objects considering boundary layer effects, graduates will be able to design complex cohesion type turbines or blede turbines.
2160602.4-PO4	2	By analizing and design of streamlined objects considering boundary layer effects, graduates will be able to do some experiments realted to heat and mass transfer,aircrafts, ships, submarines.

2160602.4-PO5	1	By analizing and design of streamlined objects considering boundary layer effects, graduates will be able to use modern IT tools to check performance characteristics of aircraft, submarines etc.
2160602.5-PO1	1	With knowledge of model studies for fluid flow problems, graduates will apply their knowledge using mathamatics, science , engineering fundamentals to solve fluid flow problems.
2160602.5-PO2	3	With knowledge of model studies for fluid flow problems, graduates will apply their knowledge in identify, formulate and analyze fluid flow problems based on model parameter.
2160602.5-PO3	2	With knowledge of model studies for fluid flow problems, graduates will apply their knowledge in design of pipe flow as well as opan channel flow with specified needs.
2160602.5-PO4	2	With knowledge of model studies for fluid flow problems, graduates will apply their knowledge to conduct experiments on model of various hydraulic structures to solve fliud flow problems.

Program Specific Outcome (PSOs)

1. Graduates will be able to actively apply technical knowledge and skill for solving day to day civil engineering problems.
2. Graduates will be able to engage themselves to achieve expertise in design and analysis of structures by modern civil engineering tools.
3. Graduates will be able to become responsible technocrats to deliver environmental friendly sustainable solutions.
4. Graduates will be able to capable of design functionally efficient structures knowing the latest development in the field of civil engineering.
5. Graduates will be able to pursue their career as professional entrepreneur by using knowledge and soft skills.

CO-PSO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
C602.1	2	-	3	2	1	-	-	-	-	-	-	-	2	3	-	-	2
C602.2	2	3	3	1	2	-	-	-	-	-	-	-	3	3	1	-	-
C602.3	2	3	3	2	1	-	-	-	-	-	-	-	2	3	-	2	-
C602.4	-	1	2	2	1	-	-	-	-	-	-	-	2	3	-	-	2
C602.5	1	3	2	2	-	-	-	-	-	-	-	-	3	2	-	2	1
C602																	

3: Strong 2: Moderate 1: Low -:NA

CO-PSO Mapping & Justification

Mapping	Level	Justification
2160602.1-PSO1	2	With knowledge of fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions, graduates will be able to apply their knowledge to solve complex pipe networks problems.
2160602.1-PSO2	3	With knowledge of fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions, graduates can design pipe networks with modern civil engineering tools.
2160602.1-PSO5	2	With knowledge of fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions, graduates will be able to pursue their carrier as professional entrepreneur in the field of plumbing nework.
2160602.2-PSO1	3	By Comprehend ,illustrate and study the performance characteristics of hydraulic machines, graduates will be abe to apply their knowledge related to hydraulic machines problems.

2160602.2-PSO2	3	By Comprehend, illustrate and study the performance characteristics of hydraulic machines, graduates will analyze or identify the performance of hudraulic machines with modern engineering tools.
2160602.2-PSO3	1	By Comprehend ,illustrate and study the performance characteristics of hydraulic machines, graduates will be able to become responsible technocrafts in the field of hydraulic.
2160602.3-PSO1	2	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle, graduates can solve real field open channel flow problems.
2160602.3-PSO2	3	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle, graduates will do experiments on open channel flow with modern civil engineering tools and solve hydraulic problems.
2160602.3-PSO4	2	With knowledge of design of Design optimal sections of Open channel flow; calculate forces on sluice gates considering specific energy and momentum principle, graduates will be able to design open channels with latest development in the field of fluid mechanics.
2160602.4-PSO1	2	By analyzing and design of streamlined objects considering boundary layer effects, graduates will apply their knowledge in the desihn of aircraft, submarine, ships etc.
2160602.4-PSO2	3	By analyzing and design of streamlined objects considering boundary layer effects, graduates can do design of turbines, ships, turbulent boundry flow with modern civil engineering tools.
2160602.4-PSO4	2	By analyzing and design of streamlined objects considering boundary layer effects, graduates can cove problems realted to turbines, aircrafts, submarine etc. with latest development in the filed of civil engineering.
2160602.4-PSO5	2	By analyzing and design of streamlined objects considering boundary layer effects, graduates can become professional entrepreneur in the manufacturing filed of aircrafts, submarines, ships etc.
2160602.5-PSO1	3	With knowledge of model studies for fluid flow problems, graduates will apply their knowledge using mathamatics, science , engineering fundamentals to solve fluid flow problems.
2160602.5-PSO2	2	With knowledge of model studies for fluid flow problems, graduates will apply their knowledge in identify, formulate and analyze fluid flow problems with latest civil engineering tools.
2160602.5-PSO5	1	With knowledge of model studies for fluid flow problems, graduates can become professional entrepreneur in the filed of hydraulic structures models.

GUJARAT TECHNOLOGICAL UNIVERSITY

Civil Engineering

RAILWAY, BRIDGE AND TUNNEL ENGINEERING

SUBJECT CODE: 2160603

B.E. 6thSEMESTER

Programme: CIVIL ENGINEERING	Degree: B.E.
Course Code: 2160603 R.B.T.E.	Semester: 6
Credits: 4	Contact hours: 3 (Theory) + 1 (Tutorial)

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Syllabus:

1	Introduction: Development of railways in India, Permanent way and railway track components, different gauges in India, conning of wheels, function and types of rails, rail sections, defects in rails, creep of rails, rail joints and welding of rails, sleepers – types, spacing and density, rail fixtures and fastenings, ballast, subgrade and embankment..
2	Geometric design of railway track: gradients, grade compensation, speed of trains on curves, super elevation, cant deficiency, negative super elevation, curves, widening on curves.
3	Railway traction and track resistance, stresses in railway track – rails, sleepers, ballast. Points and crossings – turnouts, switches, crossings. Track junctions – types, splits, diamond, gauntlet, scissor crossovers. Railway stations - requirements, facilities, classifications, platforms, loops, sidings. Railway yards – types, required equipments in yards. Signalling and control system – objectives, classification, Interlocking of signals and points.
4	Railway track - construction, drainage, maintenance. Recent developments in railways – high speed trains, modernization in track for high speed, Metro rails, Monorail, automation in operation and control. Safety in railways – accidents and remedial measure.
5	Bridges: Classification of bridges – with respect to construction materials, structural behavior of super structure, span, sub structure, purpose. Temporary and movable bridges. Factors affecting site selection. Various loads/stresses acting on bridges. Bridge hydrology – design discharge, water way, afflux, scour depth, economical span. Bridge components – foundation, piers, abutments, wing wall, approach, bearings, floor, girders, cables, suspenders. Methods of erection of different types of bridges. River training works and maintenance of bridges. Testing and strengthening of bridges. Bridge architect.
6	Tunnels: Necessity/advantage of a tunnel, Classification of Tunnels, Size and shape of a tunnel, Alignment of a Tunnel, Portals and Shafts, Methods of Tunneling in Hard Rock

	and Soft ground, Mucking, Lighting and Ventilation in tunnel, Dust control, Drainage of tunnels, Safety in tunnel construction.

Course Outcomes:

1. **Understand** railway track components and materials
2. Geometric **design** of railway track
3. **Explain** about various components in diverging, merging and crossings of railway tracks, and control systems.
4. **Evaluate** requirements of railway track for high speed trains, safety aspects and maintenance.
5. **Describe** different classification and hydraulic design of bridges.
6. **Investigate** methods of construction, mucking, ventilation, lining and lighting of tunnels.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
C603.1	3	2	-	2	-	-	-	-	2	-	-	2	3				3
C603.2	2	3	3	2	-	-	-	-	2	-	-	-	3	3			
C603.3	3	2	2	2	2	-	-	-	2	-	-	-	3			2	
C603.4	3	3	3	-	2	2	2	-	-	-	-	-	3			2	
C603.5	3	3	3	3	3	-	2	-	-	-	-	-	3	3			
C603.6	3	3	2	2	2	-	2	-	-	-	-	-	3			3	
C603	2.83	2.66	2.75	2.2	2.25	2	2		2			2	3	3		2.3	3

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2160603.1-PO1	3	Knowledge about railway track components, their materials, size, function and importance
2160603.1-PO2	2	Analysis of problems about railway track components
2160603.1-PO4	2	Conduct investigations of complex about problems railway track components, their materials, size, function
2160603.1-PO9	2	Solve problems of railway track components with Individual and team work
2160603.1-PO12	2	Life-long learning about railway track components, their materials, size, function and importance
2160603.2-PO1	2	Knowledge about geometric design of railway track
2160603.2-PO2	3	Analysis of problems about geometric design of railway track
2160603.2-PO3	3	Geometric design of railway track
2160603.2-PO4	2	Conduct investigations for Geometric design of railway track
2160603.2-PO9	2	Solve problems of Geometric design of railway track with Individual and team work

2160603.3-PO1	3	Knowledge about various components in diverging, merging and crossings of railway tracks, stations, yards, signaling, interlocking and control systems.
2160603.3-PO2	2	Analysis of problems various components in diverging, merging and crossings of railway tracks, stations, yards, signaling, interlocking and control systems.
2160603.3-PO3	2	Designing various components in diverging, merging and crossings of railway tracks, stations, yards, signaling, interlocking and control systems.
2160603.3-PO4	2	Conduct investigations for various components in diverging, merging and crossings of railway tracks, stations, yards, signalling, interlocking and control systems.
2160603.3-PO5	2	Modern tool usage for , signalling, interlocking and control systems.
2160603.3-PO9	2	Solve problems of railway tracks, stations, yards, signalling, interlocking and control systems with Individual and team work.
2160603.4-PO1	3	Knowledge about requirements of railway track for high speed trains, safety aspects and maintenance.
2160603.4-PO2	3	Analysis of problems of railway track for high speed trains, safety aspects and maintenance.
2160603.4-PO3	3	Design of railway track for high speed trains, safety aspects and maintenance.
2160603.4-PO5	2	Modern tool usage for high speed trains, safety aspects and maintenance.
2160603.4-PO6	2	The engineer and society cooperation for high speed trains, safety aspects and maintenance.
2160603.4-PO7	2	Environment and sustainability due to high speed trains, safety aspects and maintenance.
2151603.5-PO1	3	Knowledge about different types of bridges, their components, loads/stresses acting on bridges, requirement and function of the components, hydrological design, methods of erection, maintenance of bridges.
2151603.5-PO2	3	Analysis of problems of different types of bridges, their components, loads/stresses acting on bridges, requirement and function of the components, hydrological design, methods of erection, maintenance of bridges.
2151603.5-PO3	3	Design of different types of bridges, their components, loads/stresses acting on bridges, requirement and function of the components, hydrological design, methods of erection, maintenance of bridges.
2151603.5-PO4	3	Conduct investigations for different types of bridges, their components, loads/stresses acting on bridges, requirement and function of the components, hydrological design, methods of erection, maintenance of bridges.
2151603.5-PO5	3	Modern tool usage for, methods of erection, maintenance of bridges.
2151603.5-PO7	2	Environment and sustainability due to , hydrological design, methods of erection, maintenance of bridges.
2151603.6 -PO1	3	Knowledge about importance, types, methods of construction, mucking, ventilation, lining and lighting in Tunnels
2151603.6- PO2	3	Analysis of problems of methods of construction, mucking, ventilation, lining and lighting in Tunnels

2151603.6- PO3	2	Design of different types of ventilation, lining and lighting in Tunnels.
2151603.6- PO4	2	Conduct investigations for different types of methods of construction, mucking, ventilation, lining and lighting in Tunnels.
2160603.1– PSO1	3	Students will apply technical knowledge and skill for railway track components
2160603.1– PSO5	3	Students will gain immense knowledge about railway and bridge to apply it effectively in field work.
2160603.2– PSO1	3	Students will apply technical knowledge and skill for Geometric design of railway track
2160603.2– PSO2	3	Students achieve expertise in design and analysis of structures Geometric design of railway track
2160603.3– PSO1	3	Students will apply technical knowledge and skill for components in diverging, merging and crossings of railway tracks
2160603.3– PSO4	2	Students will design functionally efficient structures components in diverging, merging and crossings of railway tracks
2160603.4– PSO1	3	Students will apply technical knowledge and skill for railway track for high speed trains
2160603.4– PSO4	2	Students will design functionally efficient structures railway track for high speed trains
2160603.5– PSO1	3	Students will apply technical knowledge and skill for classification and hydraulic design of bridges
2160603.5– PSO2	3	Students achieve expertise in design and analysis of structures classification and hydraulic design of bridges
2160603.6– PSO1	3	Students will apply technical knowledge and skill for construction, mucking, ventilation, lining and lighting of tunnels
2160603.6– PSO4	3	Students will design functionally efficient structures and construction, mucking, ventilation, lining and lighting of tunnels

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)

WATER & WASTE WATER ENGINEERING

SUBJECT CODE: 2160604

B.E. 6th SEMESTER

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Syllabus:

1	Water treatment plant: Layout plan and section of water treatment plant, Estimation of raw water discharge for treatment plant, Design period, and factors considered for selection of design period. Treatment plant site selection, factors considered, future stages of expansion, selection of treatment plant
2	Collection and conveyance of raw water from source: Intakes, types of intakes, conveyance of water, design of pumps and gravity and rising mains
3	Water treatment processes and treatment units: Plain sedimentation, aeration, sedimentation tank & its design, sedimentation with coagulation, types of coagulants, optimum dose of coagulants, mixing devices, design of flocculation unit. theory of filtration, types of filters and their comparison, design of rapid sand filter, washing of filter, methods of disinfection, methods of removing hardness Computation of dose of chemicals for removal of hardness
4	Distribution system:Layouts of distribution networks, Components of distribution system,Newton's and Hardy cross methods for network analysis, storage capacity of ESR and underground reservoir, determination of location and height of ESR.
5	Collection of sewage &estimation of its discharge: Different types of sewers, sewerage systems, variation in sewage flow,sewer appurtenance, estimation of wastewater

	discharge in a sewer in sewerage system, estimation of storm water discharge in urban area,separate and combined sewerage systems, laying and testing of sewers.
6	Unit operations/ processes for wastewater treatment: Layout plan and section of municipal wastewater treatment plant,Physical unit operation screening, flow equalization, mixing, flocculation, sedimentation. Chemical unit processes-chemical precipitation. Biological unit processes: Aerobic attached growth and aerobic suspended growth treatment processes, anaerobic suspended growth treatment processes, an aerobic suspended growth treatmentprocesses, low cost sanitation systems, septic tanks, soak pit, stabilization ponds.
7	Design of wastewater treatment units: Design of racks, screens, grit chamber, aeration units, primary & secondary clarifiers, activated sludge plant and trickling filter units, rotating biological contactors, sludge dewatering units, sludge digesters and drying beds.

Reference Books:

1. Environmental engineering volume 1 and 2 by S.K.Garg, Khanna publisher
2. Environmental engineering volume 1 and 2 by B.C.Punamia, laxmi publication
3. Environmental engineering volume 1 and 2 by Dr.P.M.Modi
4. Water supply and sanitary engineering by G.S.Birdie and J.S.Birdie
5. Environmental pollution engineering by C.S. Rao wiley eastern
6. Water supply and wastewater engineering by B.S.N Raju, Tata McGraw hill, New Delhi
7. H.S. Peavy, D.R.Row & G.Tchobanoglous, environmental engineering,Mc Graw Hill Intranational Edition
8. Viesman, Hammer and Chadik, water supply and pollution control, PHI Publication.
9. M.L.Devis and D.A.Cornwell,Introdution to environmental engineering:-2nd edition-1997,Mc Graw Hill Intranational Edition
10. Metcalf and eddy,(revised by G.Tchobanoglous) Wastewater Engineering:Treatment,disposal reuse,Tata-Mc Graw Hill,New Delhi
11. Waste water treatment plants, Planning Design and Operation, Syed Qasim, CRC Press.
12. Water Works Engineering: Planning, Design and Operation, Syed R. Qasim, Edward M. Motley, Guang Zhu, CRC Press

Course Outcomes:

1. Understand treatment technologies for water/wastewater.
2. Design of collection ,distribution and storage system for water and waste water..
3. Estimate quality and quantity of sewage
4. Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2160604.1	3	3	2	2	2	3	-	1	-	2	-	2	3	3	3	3	2
2160604.2	2	3	3	-	2	1	-	-	2	-	-	2	3	3	3	3	2
2160604.3	3	2	3	3	2	-	1	-	2	1	-	2	2	1	1	1	-
2160604.4	3	3	2	-	3	2	2	2	2	3	-	3	2	2	2	1	1
2160604.	2.7	2.7	2.5	1.2	2.2	1.5	.75	.75	1.5	1.2	-	2.2	2.5	2.2	2.2	2	1.2

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2150608.1-PO1	3	Study of water and waste water treatment require application of physics , chemistry, biochemistry, microbiology, so students will able to apply there engineering knowledge of different domain.
2150608.1-PO2	3	Students will able judge different problem faced in treatment of water and waste water.
2150608.1-PO3	2	By understanding basic concepts of water and waste treatment student will able to give appropriate solution of treatment problems.
2150608.1-PO4	2	By understanding basic concepts of water and waste treatment student will able to conduct investigation design and analysis of complex problems.
2150608.1-PO5	2	By understanding basic concepts of water and waste treatment student will able to create , select and apply moden tools to control treatment process.
2150608.1. PO6	3	By knowing different treatment technology studenrs will able to aware socity to for helth related problems.
2150608.1-PO7	1	By understanding basic concepts of water and waste treatment students will learn optimum use of water without depletion of natural resourses that will help in sustainable development.
2150608.1-PO8	2	By undstanding proper techniques of treatment and concequenses of improper treatment ,students will take responsibility to aware society for proper treatment of water and wastewater.
2150608.1-PO10	1	By undstanding proper techniques of treatment students will able to communicate helth isuues caused by improper treatment..
2150608.1-PO11	1	Student will be able to handle project related to water and waste water tretment
2150608.1-PO12	3	As the quality and quanty of water water changes with time , basic concept of treatment will help to develop new solution and it will help in life long lerning.
2150608.2-PO1	2	Design of water and waste water treatment require application of physics , chemistry, biochemistry, microbiology, so students will able to apply there engineering knowledge of different domain.
2150608.2-PO2	3	Design of water and waste water treatment involves analysis of different complex problems.

2150608.2-PO3	3	Students will able to design collection distribution and storage system for water and waste water.
2150608.2-PO5	2	Students will able to apply moden tools and software realted to design .
2150608.2-PO6	1	By knowing design of diffrenent components of treatment components students will able to solve problems of socity related to water and waste water.
2150608.2-PO9	2	All parts components of water collection distribution and storage are interconnected so it is required to work as team for complete effient design .
2150608.2-PO12	2	As the quality and quanty of water water changes with time which leads to change in design of treatment components ,so basic concept of treatment will help to develop new design solution and it will help in life long lerning.
2150608.3-PO1	3	Estimation of quality and quantity of sewage require application of physics , chemistry, biochemistry, microbiology, so students will able to apply there engineering knowledge of different domain.
2150608.3-PO2	2	By knowing quality of sewage students will able judge different problem faced in treatment waste water.
2150608.3-PO3	3	Estimation of quantity of sewage will help in proper design .
2150608.3-PO4	2	Estimation of quantity of sewage includes analysis and interpretation of data, and synthesis of the information to provide valid conclusions
2150608.3-PO5	2	Students will able to apply moden tools and software realted to estimation .
2150608.3-PO7	1	By Understanding quality of sewage students can suggest engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
2150608.3-PO9	2	Estimation of quantity quantity of sewage involve many displine so it is required to work as team for proper results .
2150608.3-PO10	1	By undstanding quantity of sewage students will able to communicate health isuues caused by improper treatment.
2150608.3-PO12	2	As the quality and quanty of waste water changes with,so basic quality of sewage will help to develop new design solution and it will help in life long lerning.
2150608.4-PO1	3	In Performance of common environmental experiments students will apply engineering knowledge of different subjects like physics , chemistry, biochemistry, microbiology etc
2150608.4-PO2	3	By knowing quality of water and waste water students will able to know problems caused by it.
2150608.4-PO3	2	Quality of water and waste water help to design different treatment unit.
2150608.4-PO5	3	Students will able to lern Different modern tool used in laboratory performance.
2150608.4-PO6	2	By knowing quality of water and waste water studenrs will able to awrew socity to for helth related problems.
2150608.4-PO7	2	By Understanding quality of water and waste water students can suggest engineering solutions in societal and environmental

		contexts, and demonstrate the knowledge of, and need for sustainable development
2150608.4-PO8	2	By Understanding quality of water and waste water students will understand responsibility of environmentntal engineer towards socity.
2150608.4-PO9	2	Determination of quantity of water and waste water involve many displine so it is required to work as team for proper results .
2150608.4-PO10	3	By undstanding quantity of water and waste students will able to communicate helth isuues caused by improper treatment.
2150608.4-PO12	3	As the quality and quanty of water water changes with time which leads to change in design of treatment components ,so basic concept of treatment will help to develop new design solution and it will help in life long lerning.
2150608.1-PSO1	3	Gradates will be able to actively apply technical knowledge realated to treatment technology for solving day to day civil engineering problems.
2150608.1-PSO2	3	Students will able judge different problem faced in treatment of water and waste water. Graduates will be able to engage themselves to achieve expertise in design and analysis of structures by modern civil engineering tools.
2150608.1-PSO3	3	By understanding basic concepts of water and waste treatment student will able to give appropriate solution of treatment problems.
2150608.1-PSO4	3	By understanding basic concepts of water and waste treatment student will able to conduct investigation design and analysis of complex problems.
2150608.1-PSO5	2	By understanding basic concepts of water and waste treatment student will able to create , select and apply moden tools to control treatment process.
2150608.2-PSO1	3	Design of water and waste water treatment require application of physics , chemistry, biochemistry, microbiology, so students will able to apply there engineering knowledge of different domain.
2150608.2-PSO2	3	Design of water and waste water treatment involves analysis of different complex problems.
2150608.2-PSO3	3	
2150608.2-PSO4	3	Students will able to design collection distribution and storage system for water and waste water.
2150608.2-PSO5	2	Students will able to apply moden tools and software realted to design .
2150608.3-PSO1	2	Estimation of quality and quantity of sewage require application of physics , chemistry, biochemistry, microbiology, so students will able to apply there engineering knowledge of different domain.
2150608.3-PSO2	1	By knowing quality of sewage students will able judge different problem faced in treatment waste water.
2150608.3-PSO3	1	Estimation of quantity of sewage will help in proper design .
2150608.3-PSO4	1	Estimation of quantity of sewage includes analysis and

		interpretation of data, and synthesis of the information to provide valid conclusions
2150608.4-PSO1	3	Performance of common environmental experiments will develop students will apply technical knowledge and skill
2150608.4-PSO2	2	By knowing quality of water and waste water students will able to know problems caused by it.
2150608.4-PSO3	2	Quality of water and waste water help to design different treatment unit.
2150608.4-PSO4	1	
2150608.4-PSO5	1	Students will able to lern Different modern tool used in laboratory performance.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)
ELEMENTARY STRUCTURAL DESIGN
SUBJECT CODE: 2160607
B.E. 6th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	0	5	70	20	10	30	0	20	150

1	Introduction: Objectives, Properties of Reinforced Concrete and Structural Steel, Loads & load combinations, Methods of Analysis, Codes & specifications, Design Philosophies - Working stress Method, Ultimate Load Method, Limit State Method, Plastic Method.
2	Limit state design of RC elements: (A) Philosophy of Limit state design: Limit state of collapse & serviceability, partial safety factors for material & loading. Limit State of Flexure: Stress-strain characteristics of concrete & reinforcing steel, Type of section-under reinforced, over reinforced & balance section, Neutral Axis depth, Moment of Resistance for singly reinforced, doubly reinforced and flanged sections. Limit State of Shear and Torsion, combined flexure & torsion, Bond & Anchorage, Development length, splicing (B) Design of Beams: Simply supported, cantilever and continuous beams (C) Design of Slab: One way, two way simply supported and continuous slabs (D) Design of Column: Classifications, Assumptions, Design of Short Columns under axial load. (E) Design of Foundations: Design of isolated footing under axial load and uni-axial bending, combined footing
3	Limit state design of RC elements: (A) Philosophy of Limit state design: Limit state of collapse & serviceability, partial safety factors for material & loading. Limit State of Flexure: Stress-strain characteristics of concrete & reinforcing steel, Type of section-under reinforced, over reinforced & balance section, Neutral Axis depth, Moment of Resistance for singly reinforced, doubly reinforced and flanged sections. Limit State of Shear and Torsion, combined flexure & torsion, Bond & Anchorage, Development length, splicing (B) Design of Beams: Simply supported, cantilever and continuous beams (C) Design of Slab: One way, two way simply supported and continuous slabs (D) Design of Column: Classifications, Assumptions, Design of Short Columns under axial load. (E) Design of Foundations: Design of isolated footing under axial load and uni-axial bending, combined footing

Reference Books (RC Design)

1. Shah & Karve; Limit State Theory & Design of Reinforced Concrete; Structure Pub., Pune
2. Dr. H.J. Shah; Reinforced concrete Vol-I; Charotar Pub. Anand
3. A.K.Jain; Design of Concrete Structures, Nemchand Publication
3. IS: 456 - Code of practice for plain and reinforced concrete
4. IS: 875 (Part I to V) - Code of practice for structural safety of Buildings Loading standards
5. IS: 1893 - Criteria for earthquake resistant design of structures
6. IS: 13920 -Code of Practice for ductile detailing of RC structure subjected to seismic force

Reference Books (Steel Design)

1. N.Subramanian; Steel Structures, Oxford Publication
2. Arya A.S. & Ajamani J.L.; Design of Steel Structures; Nemchand & Bros., Roorkee
3. Dayaratnam P.; Design of Steel Structures; Wheelor pub. co., Delhi
4. Ramamrutham S. & Narayanan R.; Design of Steel Structures; Dhanpatrai & Sons, Delhi

5. K. S. Sai Ram; Design of Steel Structures, Pearson
6. IS: 800 – 2007, Code of practice for General Construction in steel
7. IS: 875 - (Part I to V) - Code of practice for structural safety of building loading standards
8. IS: 226 - Structural steel (Standard Quality)
9. SP: 6(1) - Structural steel section
10. SP: 6(6) - Application of plastic theory in design of steel structures

Course outcomes:

After completion of the course, the student will be able to:

1. **Select** various design philosophies to plan, to draw structural layout and to understand analytical approach to be used in the design of structural elements.
2. **Evaluate** the loading conditions and **to calculate** loads as per IS Specifications .
3. **Analyse** IS code provisions for the design of basic structural members.
4. **Propose** design of basic structural elements like slab, beams, columns and foundation etc. using steel and concrete as materials.

CO-PO mapping:

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2160607.1	3	3	-	-	-	-	3	-	-	-	-	-	2	2	-	2	1
2160607.2	3	3	3	3	3	-	-	-	2	-	-	-	3	3	-	2	1
2160607.3	2	2	2	-	-	2	-	-	1	-	-	-	3	2	-	2	2
2160607.4	3	3	3	3	3	2	3	2	3	3	2	2	3	3	-	3	3
2160607	3	3	2	3	3	2	3	2	2	3	3	3	3	3	-	2	2

3: Strong 2: Moderate 1: Low -:NA

Mapping	Level	Justification
2160607.1-PO1	3	Basic knowledge of design philosophies will be gained by students
2160607.1-PO2	3	Concepts will be useful to compare different philosophy of design to design a structure.
2160607.1-PO7	3	Students will learn to decide the more suitable design philosophy helps to build sustainable structure.
2160607.2-PO1	3	Will be able to apply the basic knowledge of mathematics and engineering to analyse the structure and to analyse.
2160607.2-PO2	3	Will be able to review and identify the clauses for the loading condition as well to analyse the structure.
2160607.2-PO3	3	Will be able to calculate complex structure analysis for complex loading due to different geographical condition.
2160607.2-PO4	3	Will be able to analyse and interpret complex codal provision require to design structure.
2160607.2-PO5	3	Use of modern tools like excel,autocad etc.will be more useful to analyse the structure.
2160607.2-PO9	2	Analysis of big structure imparts team work .
2160607.3-PO1	2	Students will be able to learn to use different provision required to analyse and design .
2160607.3-PO2	2	Will be able to understand, review and identify right clause to use provisions .
2160607.3-PO3	2	Students will be able to find different aspects and provisions required for environment friendly design .
2160607.3-PO6	2	Conceptual knowledge about Indian standard codes imparts safe and legal

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING
URBAN TRANSPORTATION SYSTEM
SUBJECT CODE: 2160608
B.E. 6th SEMESTER

Type of course: Departmental Elective - I

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Urbanization, urban class groups, transportation problems and identification, impacts of transportation, urban transport system planning process, modeling techniques in planning.	4	10
2	Urban mass transportation systems: urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination.	6	15
3	Introduction to land use planning models, land use and transportation	9	20

	interaction. The transportation study area definition; division into traffic zones; network identification and coding; types of trips, characteristics of various surveys; home interview; roadside survey; goods, mass transit and intermediate public transport surveys; sampling and expansion factors; accuracy checks, screen line checks, consistency checks.		
4	Travel demand modeling: Trip generation-zonal regression and category analysis, Trip distribution-growth factor models, gravity model, opportunity models, Desire line diagram. Modal split analysis-trip end	**15**	**35**
	models, trip interchange models, logit models, Trip assignment techniques-route choice, diversion curves, shortest path algorithms, all-or-nothing assignment, capacity restraint models and Direct demand models.		
5	Mass transit systems: Introduction to routing and scheduling, transit system's performance parameters. Corridor identification and corridor screen line analysis. Urban forms and structures: point, linear, radial, poly-nuclear developments and suitable transit systems, Urban goods movement. Preparation of comprehensive plan and transportation system management planning.	**8**	**20**

Course Outcome:

1. Discuss about urban transportation system planning process, land use planning, different urban mass transit systems-their merits and limitations,
2. Describe different types of transportation surveys, travel demand modeling, urban mass transit system operation and urban goods movement.
3. Evaluate trip generation surveys for urban area.
4. Analyzing trip distribution, modal split and trip assignment for design of road network.

Civil Engineering
Program Specific Outcomes:

1. The students will be actively engaged in problem solving using Civil Engineering principles to address the evolving needs of the society.
2. The students will be able to achieve expertise in design and analysis of various Civil Engineering structures.
3. The students will be responsible technocrats in terms of ethics and value systems for socio-economic and environmentally sustainable development.
4. The students will develop awareness for different codes of practice and bye laws to generate engineering designs which considers functionality, aesthetic, safety and cost effectiveness of civil Infrastructure.

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
2160608.1	3	3	-	2	-	-	-	-	2	-	-	2	2	2	-	2
2160608.2	3	3	3	2	-	-	-	-	2	-	-	-	2	2	-	-
2160608.3	3	3	-	2	-	-	2	-	2	-	-	-	2	2	-	-
2160608.4	3	3	3	2	-	-	2	-	2	-	-	-	2	2	-	-
2160608	3.0	3.0	3.0	2			2		2			2	2	2	-	2

Mapping & Justification

Mapping	Level	Justification
2160608.1-PO1	3	Knowledge about urban transportation system planning process, land use planning, different urban mass transit systems-their merits and limitations.
2160608.1-PO2	3	Analysis of problems of urban transportation system planning process, land use planning, different urban mass transit systems-their merits and limitations.
2160608.1-PO4	2	Conduct investigations of complex problems of urban

		transportation system planning process, land use planning.
2160608.1-PO9	2	Individual and team work for complex problems of urban transportation system planning process, land use planning.
2160608.1-PO12	2	Life-long learning of land use planning
2160608.2-PO1	3	Knowledge about types of transportation surveys, travel demand modelling, urban mass transit system operation and urban goods movement.
2160608.2-PO2	3	Analysis of problems of transportation surveys, travel demand modelling, urban mass transit system operation and urban goods movement.
2160608.2-PO3	3	Design of travel demand modelling, urban mass transit system operation and urban goods movement.
2160608.2-PO4	2	Conduct investigations of problems of transportation surveys, travel demand modelling.
2160608.2-PO9	2	Individual and team work for solving problems of transportation surveys, travel demand modelling.
2160608.3-PO1	3	Knowledge about trip generation surveys for urban area.
2160608.3-PO2	3	Analysis of trip generation surveys for urban area.
2160608.3-PO4	2	Conduct investigations of trip generation surveys for urban area
2160608.3-PO7	2	Trip generation surveys for urban area will help in Environment and sustainability
2160608.3-PO9	2	Trip generation surveys will be done by Individual and team work for solving problems of urban area.
2160608.4-PO1	3	Knowledge of trip distribution, modal split and trip assignment for design of road network.
2160608.4-PO2	3	Analysis of trip distribution, modal split and trip assignment for design of road network.
2160608.4-PO3	3	Analysis of trip distribution, modal split and trip assignment for design of road network.
2160608.4-PO4	2	Conduct investigations of trip distribution, modal split and trip assignment for design of road network
2160608.4-PO7	2	Analysis of trip distribution, modal split and trip assignment for design of road network will help in Environment and sustainability
2160608.4-PO9	2	Analysis of trip distribution, modal split and trip assignment for design of road network will by Individual and team work for solving problems of

CO-PSO Mapping Justification

Mapping	Level	Justification
2160608.1-PSO1	2	Problem solving using urban transportation system planning process
2160608.1-PSO2	2	Design and analysis of urban transportation system
2160608.1-PSO4	2	Urban transportation system planning process considering functionality, aesthetic, safety and cost effectiveness of civil Infrastructure.
2160608.2-PSO1	2	Problem solving using transportation surveys travel demand

		modelling
2160608.2-PSO2	2	Design and analysis with the help of transportation surveys travel demand modelling
2160608.3-PSO1	2	Problem solving by conducting trip generation surveys for urban area
2160608.3-PSO2	2	Design and analysis with the help of trip generation surveys for urban area
2160608.4-PSO1	2	Problem solving by conducting trip distribution modal split and trip assignment
2160608.4-PSO2	2	Design of road network with the help of trip distribution modal split and trip assignment.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING
COMPUTATIONAL MECHANICS
SUBJECT CODE: 2160609
B.E. 6thSEMESTER

Type of course: Applied Mechanics

Prerequisite: Mechanics of Solids, Structural Analysis-I& II

Rationale: This subject is conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Stiffness Method**: Types of skeletal structures, Internal forces and deformations. Introduction and applications of stiffness member approach to analyze beams, Trusses, plane frames and grids.	14	40
2	**Stiffness Method (Special topics)** Various secondary effects like deformation of support, prestrain & temperature. Symmetry/Anti-symmetry, Oblique, supports Elastic supports, Axial-flexural interaction. Analysis of Composite structures having combination of different type of members.	10	20
3	**Nonlinear problems in solid mechanics** Material and geometric nonlinearities, Solution techniques for nonlinear equations: Newton-Raphson method.	06	10
4	**Finite Element method** 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. Introduction and Application of FEM to One dimensional (bar & beam) problems & two dimensional problems using Constant strain triangles.	12	30
5	**Computer Software Application** Application to skeletal structure and 2D problems using professional	During Laboratory/ Tutorial Hours	

	software like STAAD/SAP etc. Pre-processing, Post-processing, Modelling aspects, Type of analysis (linear, non-linear), Result interpretation.	**20**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Gere & Weaver; Matrix Analysis of framed structures, CBS Publications
2. Bhavikatti; Finite Element Analysis, New Age International Publishers
3. Desai & Abel; Finite Element Method, Tata Mcgraw hill
4. Meghre & Deshmukh; Matrix Analysis of Structures, Charotar Publication
5. A First Course in the Finite Element Method – D. L. Logan
6. Elements of Matrix and Stability Analysis of Structures by Manicka Selvam

Course outcomes:

After completing this course, the students will be able to:

1. **Solve** equilibrium and compatibility equations to determine response of statically determinate and indeterminate structures by using different methods.
2. **Calculate** displacements and internal forces of statically indeterminate structures by matrix methods.
3. **Explain** nonlinearities in material and geometry and also able to solve the nonlinear equations.
4. **Apply** concepts of finite element methods for the analysis of the structures.
5. **Use** software applications in analysis of complex and skeleton structures

Co-Po Mapping:

	CO – PO Matrix											
	PO1 Engineering knowledge	PO2 Problem analysis	PO3 Design/development of solutions	PO4 Conduct investigations of complex problems	PO5 Modern tool usage	PO6 The engineer and society	PO7 Environment and sustainability	PO8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning
CO.1	3	3	-	2	-	-	-	-	-	-	-	2
CO.2	3	3	-	2	2	-	-	-	-	-	-	2
CO.3	2	2	-	3	-	-	-	-	-	2	-	1
CO.4	2	2	-	3	-	-	-	-	-	1	-	2
CO.5	2	2	-	3	3	-	-	-	3	-	-	2
Avg. Mapping	2.4	2.4	-	2.6	2.5	-	-	-	3	1.5	-	1.8

3: Strong, 2: Moderate, 1: Low, -:NA

Justification:

Mapping	Level	Justification
CO1-PO1	3	Engineering knowledge of the students will be enhanced by learnig different methods for structural analysis.
CO2-PO1	3	Students will be able to use basic mathematical principles for the determination of displacements and other internal forces.
CO 3-PO1	2	Stduents will undertand and apply concepts of linearity and nonlinearity to the structures.
CO 4-PO1	2	Using basic engineering knowledge students will be able to understand the finite element method and use it for the analysis.
CO 5-PO1	2	Students will abe to use of software applications for the complex and skeleton structural analysis by applying engineering primciples.
CO 1-PO2	3	By determining the response and solving compatibility equations students will be able to solve the complex engineering problems.
CO 2-PO2	3	Displacements and internal forces calculation contributes to the analysis of the engineering problems.
CO 3-PO2	2	Undetanding and application of the concepts of non linearties help students to identify behaviour of material.
CO 4-PO2	2	Finite element method is a very useful tool for the problem analysis.
CO 5-PO2	2	Use of softwares for analysis of complex structures will help the students to calculate various parameters quickly.
CO 1-PO4	2	To apply research methods the ablity of students to solve compatibility equations and understand the response of the structure will be necessary.
CO 2-PO4	2	The ability to find the ineternal forces and displacements, will help students to analse or interepreate the data for complex engineering problem.
CO 3-PO4	3	Understanding about the material and geometric non linearity will contribute to analysis and interpretation of the complex problem.
CO 4-PO4	3	With the help of finite element method students will be able to find solutions for the complicated research problems.
CO 5-PO4	3	Use of software applications, lead to accurate results and time saving for the complex engineering research problem.
CO 2-PO5	2	Students will use various software applications to calculate displacements and internal forces in structures.
CO 5-PO5	3	To analyse complex engineering structures, students will use software applications and understand the limitations of each.
CO 5-PO9	3	Students will analyse the different structural members with the help of software applications in group, that will increase their capacity to work in team.
CO 3-PO10	2	Students will be able to present and explain concepts of non linearities and its effect of structrures, this exercise will improve their communication skills.
CO 4-PO10	1	Students will be able to present and explain finite element methods and its applications with its advantages and disadvantages, thus their communication will improve.
CO 1-PO12	2	Undestanding the response of the structures by different method will help students to select the appropriate method for analysis of any problem.
CO 2-PO12	2	Calulation of internal forces and displacements for determinate and

		indeterminate structures will help them to estimate value of those in real life engineering problem.
CO 3-PO12	1	Concept of nonlinearity will help students to predict the behaviour of structures.
CO 4-PO12	2	Application of finite element method will help students to analyse the complex structures.
CO 5-PO12	2	Knowledge of software applications to analyse the structures will make students more competent in professional carrier.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING

SUBJECT NAME: APPLICATION OF GEOINFORMATICS IN CIVIL ENGINEERING

SUBJECT CODE: 2170606

B.E. 7th SEMESTER

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Syllabus:

1	INTRODUCTION: Introduction to geo-informatics. Conventional methods of mapping. Advanced methods of mapping. Comparison of methods .
2	AERIAL PHHOTOGRAMMETRY:Development and classification of Photogrammetry, Aerial Photogrammetric processes: acquisition of data, classification of photographs, photographic scale, relief displacement, flight planning, stereo Photogrammetry, Stereo model compilation, principal and use of stereoscopic 3D view and parallax bar, Orthorectification, Orientation and triangulation, DEM Generation
3	REMOTE SENSING:Introduction to Electromagnetic Spectrum (EMR), interaction of EMR with atmosphere and target, Resolutions: Spatial, temporal, spectral and radiometric, sensor characteristics, satellite data products, digital imaging, digital image processing, visual image interpretation, digital image interpretation. microwave remote sensing.
4	GNSS and SCANNERS:Global Navigation Satellite System (GNSS) basic concepts, GPS (NAVSTAR), Galileo, GLONASS and Indian Regional Navigation Satellite System (IRNSS). Functional segments of GPS and components. Working principle, factors affecting, GPS setup and accessories, satellites & receivers, Differential GPS (DGPS), Applications of GNSS. Scanners: Introduction, Classification, Principle and Application
5	GIS:Structure of GIS: Cartography, Geographic mapping process, GIS data models, database management systems, Raster data representation, Vector data representation, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, Assessment of data quality, Managing data errors, Geographic data standards. GIS Data Processing, Analysis and Modeling: Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation–Quadrant counts, and nearest neighbor

	analysis – Network analysis – Surface modeling – DEM.
6	APPLICATION of GEOINFORMATICS :Principles, Concepts and Case study Case studies of applications of geo-informatics to following areas: a.Environment. b.WaterResources. c. Transportation. d. Town Planning. e. Geology. f. Disaster Management. g. Mapping

Reference Books:

1. B. Bhatta, Remote Sensing and GIS, 2nd Edition, Oxford University Press, New Delhi
2. J.R. Jensen, Introductory Digital Image Processing, Prentice-Hall, New Jersey
3. J.R. Jensen, Remote Sensing of Environment: An Earth Perspective, Pearson Education, Delhi, 2004
4. P.A. Burrough and R.A. McDonnell, Principles of Geographical Information Systems, 2nd ed. Oxford, England, Oxford University Press.
5. T.M. Lillesand, R.W. Kiefer and J.W. Chipman, Remote Sensing and Image Interpretation, 5th edition, John Wiley and Sons, India
6. George Joseph, Fundamentals of Remote Sensing, Universities Press, India, 2005

Course outcomes:

1. **Undestand**fundamental concept of Remote sensing and GIS .
2. Acquisition **manipulation** and analysis of GIS and Remote sensing**.**
3. **Interpetation**of GIS data and classification of remote sensing images .
4. **Application** and **developmen**t of RS and GIS technologies in civil engineering domains

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification:

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2170606.1	3	1	0	1	3	2	2	1	2	3	2	1	1	1	3	-	3
2170606..2	3	3	3	2	3	1	1	1	2	2	1	2	2	1	2	-	3
2170606..3	3	3	2	2	3	1	1	1	2	1	2	1	2	1	3	-	3
2170606..4	3	3	3	3	3	2	1	1	2	1	2	1	2	1	3	-	3
2170606.																	

Mapping	Level	Justification
2170606..1-PO1	3	Fundamental concept of Remote sensing and GIS knowledge require application of different engineering subjects.
2170606..1-PO2	1	Land coverage / extent is and strong problem analysis tools
2170606..1-PO4	1	The RS is satellite assistes technology
2170606..1-PO5	3	RS & GIS are most modern and highly advanced technologies.
2170606..1-PO6	2	RS & GIS are major part of disaster management methodology which is useful in social welfare .
2170606..1-PO7	2	RS & GIS reduces man power engagement and clean technologies.
2170606..1-PO8	1	RS & GIS are data driven and ethics play a vital role in transmission.
2170606..1-PO9	2	RS & GIS are large applications mostly require mostly require government interventions .
2170606..1-PO10	3	RS & GIS provide almost real –time solution
2170606..1-PO11	2	Demand for large data based public and private funding and project management
2170606..1-PO12	1	RS & GIS areas are evolving and opening up new avenues for civil engineering students.
2170606.2-PO1	3	Acquisition manipulation and analysis of GIS and Remote sensing datarequire application of different engineering subjects.
2170606..2–PO2	3	GIS and Remote sensing model is and strong problem analysis tools.
2170606..2-PO3	3	Interpetation of GIS data and classification of remote sensing images .The RS &GIS are meant to create and develop range scale civil engineering problems.
2170606..2-PO4	2	Acquisition ,manipulation and analysis of GIS and Remote sensing data is used to solve complex civil engineering problems.
2170606..2-PO5	3	RS & GIS are most modern and highly advanced technologies.
2170606..2-PO6	1	Acquisition, manipulation and analysis of GIS and Remote sensing data will help engineer and society .
2170606..2-PO7	1	RS & GIS reduces man power engagement and clean technologies
2170606..2-PO8	1	RS & GIS are data driven and ethics play a vital role in transmission.
2170606..2-PO9	2	Acquisition, manipulation and analysis of GIS and Remote sensing datarequire multidisplinary work which will promote team work .
2170606..2-PO10	2	RS & GIS provide almost real –time solution .
2170606..2-PO11	1	Demand for large data based public and private funding and project manage .
2170606..2-PO12	2	RS & GIS areas are evolving and opening up new avenues for civil engineering students.
2170606.3-PO1	3	Interpetation of GIS data and classification of remote sensing images require fundamental knolede of different engineering subjects.
2170606..3–PO2	3	Classification of remote sensing images will help in solution of complex engineering problems reaching substantiated conclusions.
2170606..3-PO3	2	Interpetation of GIS data and classification of remote sensing

		images used to solve complex civil engineering problems.
2170606..3-PO4	2	Interpetation of GIS data and classification of remote sensing images will help in investigations of complex problems
2170606..3-PO5	3	RS & GIS are most modern and highly advanced technologies.
2170606..3-PO6	1	Interpetation of GIS data and classification of remote sensing images will help engineer and society.
2170606..3-PO7	1	Interpetation of GIS data and classification of remote sensing images reduces man power engagement and promote sustainable development
2170606..3-PO8	1	RS & GIS are data driven and ethics play a vital role in transmission.
2170606..3-PO9	2	Interpetation of GIS data and classification of remote sensing images requiremultidisplinary work which will promote team work .
2170606..3-PO10	1	RS & GIS provide almost real –time solution
2170606..3-PO11	2	Demand for large data based so public and private funding and project manage .
2170606..3-PO12	1	RS & GIS areas are evolving and opening up new avenues for civil engineering students.
2170606..4-PO1	3	RS & GIS are advanced technological tools to it require knowledge of other engineering subjects.
2170606..4–PO2	3	Application of GIS and RS will help to solve complex engineering problems.
2170606..4-PO3	3	Application of GIS and RS are meant to create and develop range scale civil engineering problems.
2170606..4-PO4	3	Application of GIS and RS is used to solve complex engineering problems.
2170606..4-PO5	3	RS & GIS are most modern and highly advanced technologies.
2170606..4-PO6	2	Application of RS & GIS are major part of disaster management methodology
2170606..4-PO7	1	Applications of RS & GISsolutions are beneficialin societal and environmental contexts.
2170606..4-PO8	1	Applications of RS & GIS are data driven and ethics play a vital role in transmission.
2170606..4-PO9	2	RS & GIS are large applications mostly require mostly require government interventions .
2170606..4-PO10	1	RS & GIS provide almost real –time solution
2170606..4-PO11	2	Applications of GIS and RS demand for large data based public and private funding and project manage .
2170606..4-PO12	1	RS & GIS areas are evolving and opening up new avenues for civil engineering students.
2170606.1-PSO1	1	RS & GIS reduces the survey work hours .
2170606..1–PSO2	1	Ready information on construction site would provide a helping hours .
2170606..1-PSO3	3	The RS & GIS technologies are sustainable & environmental friendly .
2170606..1-PSO5	3	RS & GIS are emerging technologies having potential for professional works
2170606.2-PSO1	2	By knowing Acquisition manipulation and analysis of GIS and

		Remote sensing,gradates will be able to actively apply technical knowledge and skill for solving day to day civil engineering problems..
2170606..2–PSO2	1	By knowing Acquisition manipulation and analysis of GIS and Remote sensinggraduates will be able to engage themselves to achieve expertise in design and analysis of structures by modern civil engineering tools
2170606..2-PSO3	2	. By knowing Acquisition manipulation and analysis of GIS and Remote sensing graduates will be able to become responsible technocrats to deliver environmental friendly sustainable solutions
2170606..2-PSO5	3	RS & GIS are emerging technologies having potential for professional works
2170606.3-PSO1	2	RS & GIS reduces the survey work hours .
2170606..3–PSO2	1	Interpetation of GIS data and classification of remote sensing images graduates will be able to engage themselves to achieve expertise in design and analysis of structures by modern civil engineering tools.
2170606..3-PSO3	3	Interpetation of GIS data and classification of remote sensing images graduates will be able to become responsible technocrats to deliver environmental friendly sustainable solutions.
2170606..3-PSO5	3	RS & GIS are emerging technologies having potential for professional works
2170606..4-PSO1	2	Application and development of RS and GIS technologies require technical knowelge and skill to solve civil engineering problems.
2170606..4–PSO2	1	Application and development of RS and GIS technologies in civil engineering domains will help students to desoign and analysis of civil structure.
2170606..4-PSO3	3	Application and development of RS and GIS technologies in civil engineering domains will provide sustainable & environmental friendly solutions.
2170606..4-PSO5	3	RS & GIS are emerging technologies having potential for professional works

GUJARAT TECHNOLOGICAL UNIVERSITY
CIVIL ENGINEERING
DESIGN OF REINFORCED CONCRETE STRUCTURES
SUBJECT CODE: 2170607
B.E 7th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Scheme						
				Theory Marks			Practical Marks			Total Marks
L	T	P		EAE (E)	PA(M)		PA(V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Syllabus:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Building Layout and Design: Loads as per I.S., distribution & flow of loads, lateral load due to wind and seismic as per latest IS standards, load combinations, guide lines for preparation of structural layout for building. Analysis, design & detailing of G + 3 RC framed building for residential /commercial purpose including ductile detailing.	16	30
2	Design of Retaining wall: Types, behavior and application of retaining wall, stability criteria, design & detailing of cantilever & counterfort type retaining wall for various ground conditions	10	20
3	Design of Water Tank : Classification of water tank and method of analysis, permissible stresses, codal provisions, Design of circular and rectangular under-ground water tanks using IS code method, Design of elevated water tank with Intze type of container, frame and shaft type of staging and foundation considering effect of earthquake and wind forces.	12	25
4	Design of Flat Slab Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabsCheck for one way and two way shears, Limitations of Direct design method, Introduction to Equivalent frame method.	08	10
5	Earthquake Resistant Design of building: Earthquake resistant design philosophy, capacity design concept, four virtues of Earthquake Resistant design: strength, stiffness, ductility and configuration, Irregularities in structures, Lateral load distribution – Torsionally coupled & uncoupled system, Seismic coefficient Method, Ductile detailing as per IS:13920	10	15

Reference Books:

1. S. R. Karve and V. L. Shah, Illustrated Design of Reinforced Concrete Buildings, Structures Publishers.
2. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers.
3. S. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill.
4. H. J. Shah, Reinforced Concrete, Vol. I and II, Charotar Publishing.
5. Punmia B.C "Advanced RCC Design" Laxmi Publications Pvt. Ltd". 2006.
6. Varghese A. V., Advanced Reinforced Concrete, Varghese, Prentice Hall of India.
7. Sinha S. N., Reinforced Concrete Design, Tata Mc-Graw Hill, Delhi.
8. IS Codes (latest) : IS:456, IS:875 (all parts), IS:1893(P-1,2), IS:4326, IS:13920, IS: 3370 (P-1 to 4), SP:16, SP:34.

Course outcomes:

After completion of this course, students will be able to:

1. **analyze** the variousloads for wind load analysis, layout drawing and designof various structural elements of RC framed structure up to G+3, flat slab, retaining wall, water tank.
2. **identify** the typical failure modes of RC building, retaining walls, water tanks, flat slabs & prestressed concrete sections.
3. **apply** the principles, procedures and current Indian code requirements to the analysis and design.
4. **design&detail** RC structures like Retaining Wall, Water Tank and Flat slab.
5. **analyze and perform** the earthquake resistant design of structures.

CO-PO mapping

CO	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2170607.1	3	3	3	1	-	1	-	-	-	-	-	-	2	1	-	2	2
2170607.2	3	1	-	2	-	2	2	1	-	-	-	-	3	1	-	-	2
2170607.3	3	3	3	-	-	-	-	2	-	-	-	-	3	-	-	1	2
2170607.4	3	2	3	-	-	-	1	-	3	-	-	-	-	2	-	3	3
2170607.5	3	3	2	1	-	-	-	-	2	-	-	1	1	-	-	1	1
	3	2.0	3.0	1.0	0	1.0	1.0	1.0	2.0	0	0	0.2	2.0	1.0	0	2.0	2

3: Strong 2: Moderate 1: Low -:NA

CO-PO Mapping & Justification

Mapping	Level	Justification
CO1-PO		
2170607.1-PO1	3	Basic knowledge of loads , load combination, structural layout, design methods and analysis of loads can be gained by students.
2170607.1-PO2	3	Concepts learned in this subject will be useful to identify and analyze various complex problem.
2170607.1-PO3	3	Knowledge of analysis of loads and layout will useful in design of G + 3 storey building.
2170607.1-PO4	1	Research based knowledge will be useful in analysis of loads and layout by interpreting the available data.
2170607.1-PO6	1	knowledge of analysis and design will be used to assesssocietal, health, safety and the consequent responsibilities relevant to the professional engineering practice.
CO2-PO		
2170607.2-PO1	3	This fundamental knowledge of failure of reinforced concrete members will further be utilized in the design and development of structures.
2170607.2-PO2	1	Students will be able to identify and differentiate various failures and analyze the structures as per failure.
2170607.2-PO4	2	Research based knowledge and case study will help to identify the failure mode of structures.
2170607.2-PO6	2	The knowledge of failure of structure will help to assesssocietal, health, safety, legal and cultural issues and develop responsilibity of engineering practice.
2170607.2-PO7	2	Knowledge of failure mode of structure will help to design sustainable structures.
2170607.2-PO8	1	The seriousness of structural failures and process will develop ethical professional practice in students
CO3-PO		
2170607.3-PO1	3	Students will definately be able to analyze and design the various structures using the knowledge principles, procedures and current Indian code requirements.
2170607.3-PO2	3	Students will be able to analyze complex problems using procedures and principles and Indian code requirements in the design of of the
2170607.3-PO3	3	Students will design the complex engineering structures by applying the principles and Indian standards to meet the specified needs of public health and safety, and the cultural, societal, and environmental considerations.
2170607.3-PO8	2	The knowledge of Indian standard requirements will lead to apply ethical principles and commitments of professional ethics and responsibilities in students during engineering practice.
CO4-PO		
2170607.4-PO1	3	Knowledge of load analysis and layput will help to design and detail the Retaining wall, water tank , flat slab, G+3 storey building.
2170607.4-PO2	2	Knowledge of analysis of structures will help to design complex engineering problems.
2170607.4-PO3	3	Students will able to design and detail complex stuctures
2170607.4-PO7	1	The knowledge of design of complex problem make students to understand the impact of the professional engineering solutions in

		social and environmental contexts for sustainable environment solution.
2170607.4-PO9	3	A mini project design will impart team work skills.
CO5-PO		
2170607.5-PO1	3	Knowledge of earthquake resistance design principles will help analysis and design of earthquake resistant structures.
2170607.5-PO2	3	Students will able to identify and analyze the problems related to earthquake forces using research based knowledge for the sustainable solutions.
2170607.5-PO3	2	Students can be ble to use concept of earthquake resisatant design for the health and safety of society.
2170607.5-PO4	1	Research-based knowledge can be used for analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
2170607.5-PO9	2	Can understand the ethics in professional practice for safety of society in engineering practice.

CO-PSO Mapping & Justification

Mapping	Level	Justification
2170607.1-PSO1	2	Knowledge of analysis of various loads can solve day to day problems in civil engineering field.
2170607.1-PSO2	1	Students are motivated to use latest software for analysis of loads.
2170607.1-PSO4	2	Able to analize the structures like G+3 storey building, water tank, flat slab and retaining wall professionally.
2170607.1-PSO5	2	Perfect analysis of loads using standard codes.
2170607.2-PSO1	3	Knowlede of failure patterns gives the solutions of real life problems
2170607.2-PSO2	1	Use of latest software to understand the failure pattern.
2170607.2-PSO5	2	Knowledge of failure pattern develop the responsibility to deliver eco-friendly solution in professional practice.
2170607.3-PSO1	3	Students will definately be able to solve the problems related to civil engineering structures by analysis and design using the knowledge of principles, procedures and current Indian code requirements.
2170607.3-PSO4	1	Knowledge of Indian codes develops professional skills and abilities.
2170607.3-PSO5	2	Use of codal provisions in analysis and design ends in ethical solutions of problems.
2170607.4-PSO2	2	Use of softwares for design of G+3 storey building.
2170607.4-PSO4	3	Students can able to design and detail the real life RC structures professionally.
2170607.4-PSO5	3	The knowledge of design and detailing of structures make students responsible to understand the impact of the professional engineering solutions in social and environmental contexts for sustainable environment solution.
2170607.5-PSO1	1	Knowledge of earthquake resistance design principles will help in analysis and design of earthquake resistant structures.
2170607.5-PSO4	2	Develop the skill to analyze,design and detailing of earthquake resistant structures.
2170607.5-PSO5	2	Knowledge of requirement of earthquake resistant detailing of structures develops responsibility to give ethical solutions of structures.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING
SUBJECT NAME: IRRIGATION ENGINEERING
SUBJECT CODE : 2170609
B.E. 7th SEMESTER

Type of course: Civil Engineering

Prerequisite: Knowledge of Fluid Mechanics, Hydrology and Water Resources Engineering

Rationale:
To develop understanding about water requirement of crops, irrigation methods, and irrigation engineering works like weir/barrage, storage and outlet works, distribution works, regulating and cross drainage works and importance of drainage in irrigated areas.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks			Practical Marks		
L	T	P	C	ESE (E)	PA (M)		ESE (Viva)	PA (I)	
					PA	ALA			
3	2	0	5	70	20	10	30	20	150

Course Content:

1	**Introduction-** Definition, Necessity, Scope, Benefits and ill effects of irrigation, Types of irrigation schemes, Social and environmental considerations, Irrigation development in India. Water Requirement of Crops- Soil-water-plant relation- field capacity, wilting point, available water, consumptive use, Irrigation requirements – Net irrigation requirement, Field irrigation requirement, Gross Irrigation requirement, Soil moisture extraction pattern, Frequency of irrigation, Principal Indian crops, Gross command area, Culturable command area, Intensity of irrigation, Duty and delta relation, Introduction to various methods of application of irrigation water, Irrigation efficiency, assessment of irrigation water
2	**Diversion Works:** Different stages of a river and their flow characteristics, Weir and barrages, Various parts of a weir and their functions, Exit gradient, Principles of weir design on permeable formations -Bligh's creep theory and Khosla's theory **Storage and Outlet works:** Types of earthen dams, Seepage in earth dams, Gravity dams, Forces acting on a gravity dam, Rock-fill dams, Spillways, Types of spillways, Spillways gates and energy dissipation works.
3	**Distribution works:** Modes of conveying irrigation water- Types of irrigation canalscontour canal, ridge canal, side sloping canals, Canal sections-filling, cutting, partial cutting and partial filling, Balanced depth, Canal FSL, Capacity factor and Time factor, L-section, Losses of canal water, Silting and scouring of canals, Method of design of unlined section of irrigation canal, Silt theories, Lined canals, Design of lined canal, Link canal
4	**Regulating and Cross Drainage Works:** Canal falls, Cross drainage works, Types of cross drainage works, Canal escapes, Head regulator and Cross regulator, Silt ejector, Flow meters - Parshall flume, Irrigation outlets and types of outlets.
5	**Water logging-** Causes, Reclamation, Drainage principles and practice

Reference Books:

1. Irrigation & Water Power Engineering - Dr. B.C.Punmia & B.B.Pande, Laxmi Publications, (P) Ltd, New Delhi
2. Irrigation, Water Resources & Water Power Engineering - Dr. P.N.Modi, Standard Book House, Delhi
3. Irrigation, Water Power & Water Resources Engineering - Dr. K.R.Arora Standard Publishers Distributors, Delhi
4. Irrigation Engineering and Hydraulic Structures - S.K.Garg, Khanna Publishers, Delhi
5. Irrigation Engineering, S.K. Mazumder, Galgotia Publications Pvt Ltd., New Delhi

Course Objectives:

After learning the course the students should be able to:

2170609.1 To describe the basic principles and design parameters of the irrigation methods

2170609.2 To select the appropriate method for irrigation network based on specific field conditions.

2170609.3 To detect the water logged area due to over irrigation

2170609.4 To analyse the functioning of diversion headworks and energy dissipation devices

2170609.5 To design the hydraulic structures like canals, regulators, cross drainage works, falls and outlets of irrigation network.

CO-PO-PSO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2170609.1	3	2	-	-	-	3	3	2	-	3	-	-	3	-	2	-	-
2170609.2	3	3	3	2	-	-	2	3	2	-	-	2	3	2	-	-	2
2170609.3	3	3	-	-	-	2	3	-	-	-	-	2	2	-	-	-	-
2170609.4	3	3	3	2	2	-	-	2	3	2	2	2	3	3	-	-	2
2170609.5	3	3	3	2	1	-	-	2	-	-	-	2	2	3	-	-	-
2170609	3	2.8	3	2	1.5	2.5	2.67	2.25	2.5	2.5	2	2	2.6	2.67	2	-	2

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2170609.1 PO1	3	Basic Knowledge of irrigation principles & design parameters like duty-delta
2170609.1 PO2	2	Problems of finding duty-delta relation for crops
2170609.1 PO6	3	Knowledge for requirement of water to the crop
2170609.1. PO7	3	Crops will affect the environment and its plantation should be done carefully.
2170609.1. PO8	2	Students gain knowledge in ethics and duty-delta relation for crops

2170609.1. PO10	3	Overall management of the crops for the particular season and land with water avialabiity
2170609.2. PO1	3	Students will be gaining knowledge of irrigation methods
2170609.2. PO2	3	Student will be able to analyse the irrigation networks.
2170609.2. PO3	3	Student will be able to design the sprinkler/drip irrigation and also develops the networks based on design.
2170609.2. PO4	2	Investigation carried out for irrigation networks based on specific field conditions
2170609.2. PO7	2	Student will able to understand impact of environment and able to develop sustainable irrigation networks.
2170609.2. PO8	3	Student will apply the ethics for selecting the irrigation methods
2170609.2. PO9	2	Team work for identifying irrigation networks
2170609.2. PO12	2	Life long learning for various irrigation methods
2170609.3 PO1	3	By applying engineering knowledge, student will able to identify the waterlogged area due to over irrigation
2170609.3 PO2	3	Student will identify and analyse the engineering problems in water logged area
2170609.3 PO6	2	Student gain knowledge to prevent society against the waterlogging.
2170609.3 PO7	3	Students will able to analyse the ill-effect of waterlogging and affects the environment.
2170609.3. PO12	2	Life long learning for waterlogging
2170609.4. PO1	3	Apply the engineering fundamentals in functioning of headworks
2170609.4. PO2	3	Identifying the different diversion headworks and energy dissipation devices applicable in irrigation engineering
2170609.4. PO3	3	Develop the complete irrigation networks with designing the diversion headworks, falls etc.
2170609.4. PO4	2	Conduct the investigation for location of headworks
2170609.4. PO5	2	Modern techniques like GIS, GPS & RS shall be used for finding location of headworks.
2170609.4. PO8	2	Apply ethical principles in anylysing the diversion headworks and energy dissipation devices and also follow rules/norms of the engineering practice.
2170609.4. PO9	3	Function effectively as as individual and as a team member while analysing the irrigation structures
2170609.4. PO10	2	Write reports and design documents while analysing the irrigation structures
2170609.4. PO11	2	Works as a leader or member with understanding of engineering principles to manage the irrigation projects
2170609.4. PO12	2	Continous learning of new technology for energy dissipation devices
2170609.5. PO1	3	Apply the engineering fundamentals in designing of hydraulic

		structures.
2170609.5. PO2	3	Fromulate the design steps of canals, cross drainage works, canal falls by applying the principles of mathematics and engineering science.
2170609.5. PO3	3	Designing the various irrigation structures like canals, regulators, cross drainage works, falls and outlets of irrigation network.
2170609.5. PO4	2	Student will able to carry out survey or investigation for data required in design of canal and other allied structures
2170609.5. PO5	1	Student will able to select appropriate IT tools for location or alignment of canals
2170609.5. PO8	2	Follow ethical principles and norms of engineering practices in designing as well as in monitoring of irrigation structures
2170609.5. PO12	2	Continous learning of new methods and technology for designing the irrigation structures.
2170609.1 PSO1	3	Students gain knowledge to identify the various principles and design parameters of irrigation.
2170609.1 PSO3	2	Easily recognize the structure in broadest context of technological change in irrigation
2170609.2 PSO1	3	Students gain technical knowledge of irrigation methods
2170609.2 PSO2	2	Students are motivated for participating in various technical events, technical tours etc. for achieving expertise in design and analysis of irrigation schemes
2170609.2 PSO5	2	Real life problems on irrigation engineering are given to students as a project works.
2170609.3 PSO1	2	Students gain fundamental and technical knowledge of water logging due to over irrigation in the field
2170609.4 PSO1	3	Will able to analyse functioning of diversion headworks and energy dissipation devices
2170609.4 PSO2	3	Various technical tours arranged for achieving the expertise in analysis
2170609.4 PSO5	2	Real life problems on analysis given to students as a project works to become ethically responsible technocrats.
2170609.5 PSO1	2	Students gain knowledge of design the hydraulic structures like canals, regulators, cross drainage works, falls and outlets of irrigation network.
2170609.5 PSO2	3	Students are motivated for participating in various technical events, technical tours etc. for achieving expertise in design and analysis of irrigation structures

GUJARAT TECHNOLOGICAL UNIVERSITY
Civil Engineering
Professional Practice and Valuation
SUBJECT CODE :: 2170610
B.E. 7th SEMESTER

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory marks		Practical Marks				
				ESE	PA(M)		PA(V)		PA	
			C	(E)	PA	ALA	ESE	OEP	(I)	
3	0	2	5	70	20	10	30	0	20	150

Syllabus:

1	Computation of areas and volumes for following objects; (i) Cylinder- Area of curved surface and volume (ii) Cone- Volume and area of curved surface (iii) Frustum of cone- Volume and curved surface area (iv) Frustum of pyramid- Volume and surface area of all sides. (v) Area of sector and segment of a circle (vi) Area and volume of sphere and segment of sphere (vii) Ellipse- Area of ellipse and Units of measurements
2	Estimates- Definition, Units of measurements, types of estimates, Different methods to find the quantities of civil works. Estimated cost And its importance. Provisions of IS-1200, for working out quantities and deductions in civil works. Entering the measurements in quantity sheet and calculation of quantities of various items of civil works for residential , commercial and industrial buildings, Market rates of material and labour, Introduction to schedule of rates, Entering quantities and rates in abstract sheet, calculation of estimated cost.
3	Specifications- Definition, importance of specification , Types of specification, Care to be taken while drafting specifications, Drafting general specifications, and detailed specifications for various civil work items.
4	Rate Analysis- Definition of rate analysis, Definition of task, Determination of man power and material requirement for a given quantity of items of civil works, study of present wages of labour and prices of material in the market. Study of market rents of different construction equipments, Determination of rate of item of civil work. Working out rates of various items of civil works like 10m2 plaster,10m3 1:2:4 plain and reinforced concrete, 10m3 brick work etc.
5	Contract- Definition, legal requirements of a valid contract ,types of contracts, conditions of contract, sub contracts and contractual disputes, Arbitration.
6	Tender and Tender notice- Bidding process, Prequalification process, tender notice and its essential features, drafting tender notice, Bid submission, Analysis of tenders, Basis for evaluation and acceptance, letter of intent, work order, agreement.

7	Valuation-Definitions of value, price and cost, depreciation, sinking fund , different type of values and their significance, factor affecting value, rent and standard rent, Years purchase , valuation tables, Easement, types of easements, significance of easement in valuation, Methods of valuation of buildings and land, Estimation of values of different types of buildings and lands.

course Objectives students will be able to

1. **Prepare** estimate of various civil Engineering structures and explaining monitoring/Controling project cost
2. **Formulate** specifications for various items of civil works with a view of controlling quality of work executed at site.
3. **Prepare** rate analysis of different item of civil project works .
4. **Understand** Valuation procedures and carry out valuation of land and Civil engineering structures .
5. **Prepare** tender documents and explainining contracts .
6. **Explain** public work procedure and summarize [rofessional practices .

C O-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2170610.1	3	2	-			-	-	-		-	2	-	3	2	-	-	-
2170610.2	3			-		-	-	-		-	2	-	3		-	3	-
2170610.3	3	3											3	3			
2170610.4	3	3				2					2		3	3			1
2170610.5	3	-	-	-		3	-	-		-	2	-	3			3	2
2170610.6	3					2					2		3			1	1

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2170610.1 .PO1	3	Engineering knowledge relating to taking out quantitiesby quantity survey .required to be preparing estimate
2170610.1.PO2	2	Problems of finding quantities from various drawings required to be carried out . required to preare estimate
2170610.2.PO1	3	Students will be gaining knowledge of specification .
2170610.2.PO11	2	Specification is required in preparing contracts . A knowledge required to work in society
2170610.3.PO1	3	Knowledge of preparing rate analysis is essential for preparing estimates
2170610.3.PO2	3	Analysis of rate is very important to be done for preparing estimate
2170610.4.PO1	3	Knowledge of valuation is required .

2170610.4.PO2	3	Valuation procedure includes many analysis
2170610.4.PO6	2	To work in society Civil Engineer requires knowledge of valuation
2170610.4.PO11	2	As a part of project management valuation is required to done .
2170610.5.PO1	3	Civil Engineer must have knowledge of preparing contract papers, Tender notices and Tender papers .
2170610.5.PO6	3	Civil Engineer by tenders and contracts works in society with other contractors and stake holders
2170610.5PO 11	2	As a part of project management contract /tender papers need to be prepared
2170610.6PO 1	3	Civil Engineer requires essential knowledge of Public works
2170610.6PO6	2	Engineer requires essential knowledge of PWD procedure to work in society
2170610.6PO 11	2	As a part of project management PWD procedure is required to be considered .

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Civil Engineering
SUBJECT NAME: Earthquake Engineering
SUBJECT CODE: 2170612
B.E. 7th SEMESTER

Type of course: Applied Mechanics

Prerequisite: Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure.

Rationale: This subject is conceptual applications of principles of dynamics and earthquake resistant design & detailing of RC structures. Some special topics like Earthquake resistant masonry structures, liquefaction, structural controls and seismic strengthening are included aiming students know that these are challenges in this subject. This subject is useful to understand the behavior of the structure subjected to earthquake forces and earthquake resistant design of the structure.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Earthquake Basics**: Interior of Earth, plate tectonics, faults, consequences of earthquake, Basic parameters of earthquake, magnitude & intensity, scales, Seismic zones of India, damages caused during past earthquakes (worldwide).	3	10
2	**Fundamentals of Earthquake Vibrations of buildings** Static load v/s Dynamic load (force control and displacement control), simplified single degree of freedom system, mathematical modelling of buildings, natural frequency, resonance v/s increased response, responses of buildings to different types of vibrations like free and forced, damped and un-damped vibration, response of building to earthquake ground motion, Response to multi degree (maximum three) of freedom systems up to mode shapes.	11	25
3	**Design Philosophy:** Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant	11	25

	structures (strength, stiffness, ductility and configuration), seismic structural configuration, Introduction to IS: 1893 (Part I), IS: 875 (Part V). Seismic load: **Seismic Coefficient Method** – base shear and its distribution along height. Introduction to Response spectrum, IS code provisions.		
4	**Lateral Loads on Buildings:** **Lateral Load Distribution (SDOF):** Rigid diaphragm effect, centers of mass and stiffness, torsionally coupled and uncoupled system. **Lateral Load Analysis:** Analysis of frames using approximate methods like portal & cantilever methods	6	15
5	**Ductile Detailing:** Concepts of Detailing of various structural components as per IS: 13920 provisions.	5	10
6	**Special topics**: Introduction to Earthquake Resistant Features of un-reinforced & reinforced masonry Structure, Confined Masonry, Soil liquefaction, Structural controls, Seismic strengthening.	6	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**20**	**20**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Manish Shrikhande & Pankaj Agrawal; Earthquake resistant design of structures, PHI Publication, New Delhi
2. S.K.Duggal; Earthquake resistance design of structures; Oxford University Press, New Delhi.
3. A.K.Chopra; Dynamics of structures , Pearson, New Delhi
4. Clough & Penzin; Dynamics of structures
5. Park & Pauly; Behaviour of RC structure
6. John M.Biggs; Introduction to Structural Dynamics
7. C V R Murthy - Earthquake Tips, NICEE
8. IITK-GSDMA EQ26 – V -3.0 Design Example of a Six Storey Building
9. S S Rao; Mechanical Vibration; Pearson, New Delhi.

10. **IS Codes:**
    - Criteria for earthquake resistant design General provision & Building - IS: 1893 (Part I)- 2002
    - Code of Practice for Ductile Detailing of RC Structures - IS: 13920 (1993).
    - Code of Practice for earthquake resistant design & Construction of buildings – IS 4326 (1993).
    - Improving Earthquake Resistance of Earthen Buildings - IS 13827(1993)
    - Guide lines for Improving Earthquake Resistance low strength masonry buildings - IS 13828 (1993)

Course outcomes:

After completing this course, the students will be able to:

1. **Evaluate** the response of SDOF & MDOF structural system subjected to vibration including earthquake.
2. **Apply** the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings.
3. **Illustrate** and determine the lateral forces generated in the structure due to earthquake.
4. **Explain** the concept of ductile detailing in RC structures.

Co-Po Mapping:

	CO – PO Matrix											
	PO1 Engineering knowledge	PO2 Problem analysis	PO3 Design/development of solutions	PO4 Conduct investigations of complex problems	PO5 Modern tool usage	PO6 The engineer and society	PO7 Environment and sustainability	PO8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning
CO.1	3	3	2	2	-	-	-	-	-	-	-	-
CO.2	3	2	3	3	-	2	-	2	-	2	-	3
CO.3	3	3	2	3	3	-	-	-	-	-	-	-
CO.4	3	2	2	-	-	2	-	-	-	3	-	3
Avg. Mapping	3	2.5	2.25	2.66	3	2	-	2	-	2.5	-	3

3: Strong, 2: Moderate, 1: Low, -:NA

Justification:

Mapping	Level	Justification
CO1-PO1	3	Students will use basic engineering knowledge in to understand the response of the SDF and MDF structural systems due to vibrations in earthquake.
CO2-PO1	3	Students will be able to calculate and apply earthquake resistant structural design concept and understand lateral load distribution in structures.
C03-PO1	3	To determine lateral forces students will use basic mathematical knowledge and engineering principles.
CO4-PO1	3	To understand and apply the concept of ductile detailing students will

		be able to use engineering knowledge.
CO1-PO2	3	Students will analyse the response of SDF and MDF structural system due to vibrations of earthquake.
CO2-PO2	2	Student will be identify the parameters for the earthquake resistant structural design.
CO3-PO2	3	Students will be able to analyse the structures for the lateral loads generated in the structures due to earthquake.
CO4-PO2	2	Students will be able to identify the need of ductile detailing in specific part of the structural members.
CO1-PO3	2	To learn and understand the respose of the structural systems to the earthquake vibrations help students to design and solve the complex problems.
CO2-PO3	3	Earthquake resistant design concepts will unable students for the design of earthquake resistant structures.
CO3-PO3	2	Lateral load distribution and determination will help students to design the structures.
CO4-PO3	2	For the effective and economical earthquake resistant structures the concepts of ductile detailing is important for the students.
CO1-PO4	2	The understanding and application of respose of the structures help students to apply it for complex problem analysis in earthquake engineering.
CO2-PO4	3	Students will be able to investigate the problem and design earthquake resistant structures .
CO3-PO4	3	Understanding of lateral load distribution and calculation will help students to interpreate the data of complex problems.
CO3-PO5	3	To calculate the lateral loads for the structures students will be able to select and use diffrent software applications.
CO2-PO6	2	Students will be able to summerize and apply the concepts of earthquake resistance bulidng design leads to safety of the society.
CO4-PO6	2	The concept of ductile detailing understanding and application will ultimately concern the safety of the people from the earthquake.
CO2-PO10	2	Students will be able to communicate and present concepts of earthquake resistant designs.
CO3-PO10	3	Students will be able to prepare presentation and summarize the codal provisions for ductile detailing of structures.
CO2-PO12	3	By learning and applying the concepts of earthquake resistant structural design. the students will be able to design earthquake resistant structures as a professional.
CO3-PO12	3	By applying the concept of ductile detailing the students will be able to design safe and serviceable structures as an engineer.

GUJARAT TECHNOLOGICAL UNIVERSITY

SUBJECT NAME: TRAFFIC ENGINEERING (DEPARTMENT ELECTIVE II)
SUBJECT CODE: 2170613
B.E. 7thSEMESTER
Type of course: Department Elective II

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

ESE-End Semester Exam, PA-Progressive Assessment, E-External, M-Mid semester, V-Viva (External) , I-Internal, ALA-Active Learning Assignment, OEP-Open Ended Problem**.**

Content:

Sr. No.	**Content**	**Total Hrs**	**% Weightage**
1	Traffic Characteristics: (i) Road user's characteristics - general human characteristics, physical, mental and emotional factors, factors affecting reaction time, PIEV theory. (ii) Vehicular characteristics :(static and dynamic), Characteristics affecting road design-width, height, length and other dimensions. Weight, power, speed and braking capacity of a vehicle.	**8**	**20**
2	Traffic Studies: - Traffic volume count, methods of traffic volume count, Manual, mechanical, videography, passenger car unit. Presentation of traffic volume count. Speed studies, spot speed studies speed and delay studies and its presentation .Origin and destination studies. Necessity of parking studies types of parking	**14**	**30**

	off street parking, on street parking, Accident studies, causes of accidents, accident records condition and collision diagram, preventive measures.		
3	Traffic regulation: - traffic signs types of traffic signs, regulatory , mandatory, warning signs route marker, lane marking, lane width	**10**	**20**

	standards as IRC . Necessity of traffic signals criteria for providing traffic signals types of traffic signals. Methods of designing traffic signals.		
4	Street Lighting: (i) Methods of light distribution. (ii) Design of street lighting system. (iii)Definitions- Luminaire, foot candle, Lumen, utilization and maintenance factors. (iv) Different types of light sources used for street lighting. (v) Fundamental factors of night vision.	**10**	**15**
5	Traffic geometrics:- basic geometric elements, cross roads, rotary intersections grade separated intersection, clover leaf, fully and partial, terminal facilities	**6**	**15**

Course Outcome:

i) Analyze different types of Traffic Surveys

ii) Explain the reasons of accidents and their preventive measures

iii) Design of traffic signals at intersections and rotary intersection

iv) Understand various traffic regulation and control devices.

. **Civil Engineering**

Program Specific Outcomes:

1. The students will be actively engaged in problem solving using Civil Engineering principles to address the evolving needs of the society.
2. The students will be able to achieve expertise in design and analysis of various Civil Engineering structures.
3. The students will be responsible technocrats in terms of ethics and value systems for socio-economic and environmentally sustainable development.
4. The students will develop awareness for different codes of practice and bye laws to generate engineering designs which considers functionality, aesthetic, safety and cost effectiveness of civil Infrastructure.

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
2170613.1	2	3	2	2	-	2	2	-	-	-	-	-	2	2	2	-
2170613.2	2	3	2	3	-	3	-	-	-	-	-	2	2	2	-	-
2170613.3	2	3	3	2	-	-	2	-	2	-	-	-	2	3	2	2
2170613.4	2	2	-	-	-	2	3	-	-	-	-	3	2	2	-	2
2170613	2.0	2.75	2.33	2.33		2.33	2.33		2			2.5	2	2.25	2	2

Mapping & Justification

Mapping	Level	Justification
2170613.1-PO1	2	Basis on which the Road Traffic delay, congestion, Accident problems will be understood
2170613.1-PO2	3	Basis on which the Road Traffic delay, congestion, Accident problems will be analysed
2170613.1-PO3	2	Basis on which the solutions of Road Traffic delay, congestion, Accident problems will be designed
2170613.1-PO4	2	Conduct investigations of complex problems of Road Traffic delay, congestion, Accident problems will be designed
2170613.1-PO6	2	The engineer and society will solve the problems of Road Traffic delay, congestion, Accident .
2170613.1-PO7	2	Solving of Road Traffic delay, congestion, Accident problems will make the environment good and sustainable
2170613.2-PO1	2	Knowledge of real time problem of Road Traffic
2170613.2-PO2	3	Analysis of real time problem of Road Traffic
2170613.2-PO3	2	Design of the preventive measures of real time problem of Road Traffic
2170613.2-PO4	3	Conduct investigations of complex problems of accidents and suggest their preventive measures
2170613.2-PO6	3	Help the society by reducing accidents by preventive measures
2170613.2-PO12	2	Life-long learning of accidents and their preventive measures
2170613.3-PO1	2	Knowledge of problems related to traffic signals at intersections and rotary intersection
2170613.3-PO2	3	Analysis of problems related to traffic signals at intersections and rotary intersection
2170613.3-PO3	3	Design of solutions of problems related to traffic signals at intersections and rotary intersection
2170613.3-PO4	2	Conduct investigations of complex problems of Design of traffic

		signals at intersections and rotary intersection
2170613.3-PO7	2	Design of traffic signals at intersections and rotary intersection to make the Environment user friendly and sustainable
2170613.3-PO9	2	With the help of individual and team work solve the problem of traffic signals at intersections and rotary intersection
2170613.4-PO1	2	Knowledge of traffic regulation and control devices
2170613.4-PO2	2	Analysis of problems related to traffic regulation and control devices
2170613.4-PO6	2	Awareness of various traffic regulation and control devices will reduce the accidents in the society
2170613.4-PO7	3	Awareness of various traffic regulation and control devices will improve the Environment and sustainability
2170613.4-PO12	3	Awareness of various traffic regulation and control devices is life-long learning

CO-PSO Mapping Justification

Mapping	Level	Justification
2170613.1-PSO1	2	The Road Traffic delay, congestion, Accident problems will be understood
2170613.1-PSO2	2	The Road Traffic delay, congestion, Accident problems will be analysed
2170613.1-PSO3	2	The socio-economic and environmentally sustainable Development will be done
2170613.2-PSO1	2	Problem solving using reasons of accidents and their preventive measures
2170613.2-PSO2	2	Design and analysis of accidents
2170613.3-PSO1	2	Problem solving using Design of traffic signals at intersections and rotary intersection
2170613.3-PSO2	3	Design and Analyses of traffic signals at intersections and rotary intersection
2170613.3-PSO3	2	Design of traffic signals at intersections and rotary intersection for environmentally sustainable development.
2170613.3-PSO4	2	Design of traffic signals at intersections and rotary intersection for aesthetic, safety
2170613.4-PSO1	2	Problem solving using Traffic control devices
2170613.4-PSO2	2	Design and Analyses of traffic control devices
2170613.4-PSO4	2	Understand various traffic regulation and control devices for aesthetic, safety

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING
SUBJECT NAME: DESIGN OF HYDRAULIC STRUCTURES
SUBJECT CODE : 2180601
B.E. 8th SEMESTER

Type of course: Civil Engineering

Prerequisite: Knowledge of Fluid Mechanics, Hydrology and Water Resources engineering and Irrigation Engineering

Rationale:
Develop understanding of principles of design of embankment dam, gravity dam, spillways and canal falls and regulation works.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks			Practical Marks		
L	T	P	C	ESE (E)	PA (M)		ESE (Viva)	PA (I)	
					PA	ALA			
3	1	0	4	70	20	10	30	20	150

Course Content:

1	**Elements of dam engineering** Classification of dams, their merits and demerits, characteristics of concrete and embankment dams, site selection of dam and selection of type of dam
2	**Embankment dam engineering:** Nature and classification of soil- engineering characteristics of soil, principles of design – Material and construction- Internal seepage – Stability analysis and stresses, Phreatic line in earth dam, Settlement and deformation in rock fill embankments
3	**Concrete dam engineering:** Loading -Concepts and criteria, Gravity dam analysis design features and stability- Principal stress, elementary profile of gravity dam, practical profile of dam, low and high gravity dam, joints and galleries in dam-Concrete for dams –roller compacted concrete gravity dams
4	**Dam outlet works:** Spillways – Ogee spillway - cavitation on spillway – design features- design principles and design of spillways Design of a Chute spillways –Energy dissipation – stilling basins – plunge pools
5	**Drop structure** Design of a Sarda fall and Glacis fall, Design of Cross regulator and head regulator

Reference Books:

1. Introduction To Water Resources And Waterpower Engineering, By Dr. P N Modi , Standard Publication, Delhi
2. Irrigation And Water Resources Engineering, By G L Asawa, Pub:- New Age Int. Ltd.
3. Irrigation Engineering and Hydraulic Structures by S.K. Garg, Khanna Publishers

4. Hydraulic Structures, By P. Novak, Pub. Unwin Hyman, London Handbook of Dam Engineering, By Golze', Pub:- Van Nostrand Reinhold
5. Engineering for Dams, By Creager WP, Justin J D and Hinds J, Weily Pub. New York

Course Objectives:

After learning the course the students should be able to:

2180601.1 **Classify** the different types of hydraulic structures like dam, weir, barrage etc.
2180601.2 **Analyse** stability of embankment dam.
2180601.3 **Compute** normal stresses, principle stresses and shear stresses at heel and toe of dam.
2180601.4 **Design** outlet works like spillways, energy dissipation structures and drop structures.

CO-PO-PSO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2180601.1	3	-	-	1	-	2	2	-	-	-	-	3	3	-	2	-	-
2180601.2	3	3	2	2	-	-	-	3	2	3	-	3	3	2	-	-	2
2180601.3	3	3	3	-	2	-	-	-	3	-	-	2	3	2	-	-	-
2180601.4	3	3	3	3	1	-	-	3	2	2	-	2	3	3	-	-	2
2180601	3	3	2.67	2	1.5	2	2	3	2.33	2.5	-	2.5	3	2.33	2	-	2

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
2180601.1 PO1	3	Gain knowledge of different hydraulic structures
2180601.1 PO4	1	Use or apply theory principles for hydraulic structures
2180601.1 PO6	2	Student gain knowledge to aware the society for imporatance of hydraulic structures.
2180601.1 PO7	2	Understand the importance of structures in societal and environmental context
2180601.1 PO12	3	Easily recognize the structure in broadest context of technological change
2180601.2 PO1	3	Apply the engineering fundamentals in stability analysis of embankment dams
2180601.2 PO2	3	Identify the various stability conditions of dams using basic principles and also analyse it
2180601.2 PO3	2	Gives the different design solutions to enhance the stability of embankment dams
2180601.2 PO4	2	Students will able to use their theory knowledge to analyse the stability of dams

2180601.2 PO8	3	Apply ethical principles & takes responsibilities for stability of embankment dams .
2180601.2 PO9	2	Function efficiently individual or as a team member while analysing the stability
2180601.2 PO10	3	Able to prepare a good stability report & also make effective presentation for the same
2180601.2 PO12	3	Continous learning of new technology for stability analysis.
2180601.3 PO1	3	Stress can be computed with the help of fundamentals of maths, science & engineering principles
2180601.3 PO2	3	Identifying the various stresses acting on heel or toe of the dam
2180601.3 PO3	3	Calculate the various forces acting of the body of dam and based on that develop the complete stress distribution diagram
2180601.3 PO5	2	Various numerical techniques or IT tools shall be used while calculating the stresses
2180601.3 PO9	3	Function efficiently individual or as a team member while designing the dams
2180601.3 PO12	2	Life long learning for various stresses
2180601.4 PO1	3	Apply the engineering fundamentals in designing of outlet works and drop strucures
2180601.4 PO2	3	Identify the design problems and formulate the most likely solutions using principles of maths, science and engineering
2180601.4 PO3	3	Student will able to design various dam outlet works and drop structures based on different field conditions
2180601.4 PO4	3	Student will able to carry out survey or investigation for data required in designing of dam outlet works and drop structures
2180601.4 PO5	1	Application of GIS & RS can be used in designing
2180601.4. PO8	3	Apply ethical principles in designing and also follow rules/norms of the engineering practice.
2180601.3 PO9	2	Function efficiently individual or as a team member while designing the dams outlets works and drop strucures
2180601.3 PO10	2	Able to prepare design documents and give effective presentations
2180601.3 PO12	2	Continous learning of new methods and technology for designing the structures.
2180601.1 PSO1	3	Students gain knowledge to identify the various hydraulic structures
2180601.1 PSO3	2	Easily recognize the structure in broadest context of technological change
2180601.2 PSO1	3	Students gain technical knowledge to analyse the stability of dams
2180601.2 PSO2	2	Students are motivated for participating in various technical events, technical tours etc. For achieving expertise in design and analysis of structures
2180601.2 PSO5	2	Real life problems on analysis of embankment dams are given to students as a project works.

2180601.3 PSO1	3	Students gain fundamental and technical knowledge to compute stress acting at toe/heel of the dam
2180601.3 PSO2	3	Various design problems given to students & motivate them to solve it
2180601.4 PSO1	3	Will able to design dam outlet works and drop structures
2180601.4 PSO2	3	Various technical tours arranged for achieving the expertise in design
2180601.4 PSO5	2	Real life problems on designing are given to students as a project works to become ethically responsible technocrats.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING
SUBJECT NAME: HARBOUR AND AIRPORT ENGINEERING
SUBJECT CODE: 2180602
B.E. 8th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

SYLLABUS:

Sr. No.	Contents	Total Hrs.	% Weightage
	A. HARBOUR ENGINEERING		
1	**General:** History of water transportation at world level and at national level development and policy, classification of harbours, natural and artificial. Major ports in India, administrative set up.	**1**	**3**
2	**Harbour Planning:** Harbour components, ship characteristics, characteristics of good harbour and principles of harbour planning, size of harbour, site selection criteria and layout of harbours. Surveys to be carried out for harbor planning.	**3**	**7**
3	**Natural Phenomena:** Wind, waves, tides formation and currents phenomena, their generation characteristics and effects on marine structures, silting, erosion and littoral drift.	**3**	**7**
4	**Marine Structures:** General design aspects, breakwaters - function, types general design principles, wharves, quays, jetties, piers, pier heads, dolphin, fenders, mooring accessories – function, types, suitability, design and construction features.	**9**	**15**
5	**Docks and Locks:** Tidal basin, wet docks-purpose, design consideration, operation of lock gates and passage, repair docks - graving docks, floating docks.	**3**	**7**
6	**Port Amenities and Navigational Aids:** Ferry, transfer bridges, floating landing stages, transit sheds, warehouses, cold storage, aprons, cargo handling equipments, purpose and general description, Channel and entrance demarcation, buoys, beacons, light house, electronic communication devices.	**3**	**7**
7	**Harbour Maintenance:** Costal protection-purpose and devices, dredging, purpose, methods, dredgers-types, suitability, disposal of dredged materials .mechanical and hydraulic dredgers.	**2**	**5**
	B. AIRPORT ENGINEERING		
1	**General:** History, development, policy of air transport, aircrafts, aerodromes, air transport authorities, air transport activities, aircrafts and its characteristics, airport classifications as per ICAO.	**2**	**5**

2	**Airport Planning :** Regional planning-concepts and advantages, location and planning of airport as per ICAO and F.A.A. recommendations, airport Elements -airfield, terminal area, obstructions, approach zone, zoning laws, airport capacity, airport size and site selection, estimation of future air traffic, development of new airport, requirements of an ideal airport layout.	**6**	**10**
3	**Run Way Design:** Wind rose and orientation of runway ,wind coverage and crosswind component, factors affecting runway length, basic runway length, and corrections to runway length, runway geometrics and runway patterns (configurations).Runway marking, threshold limits cross section of runway	**5**	**10**
4	**Taxiway Design:** Controlling factors, taxiway geometric elements, layout, exit taxiway, location and geometrics, holding apron, turnaround facility. Aprons -locations, size, gate positions, aircraft parking configurations and parking systems, hanger-site selection, planning and design considerations, Fuel storage area, blast pads. wind direction indicator	**3**	**10**
5	**Terminal Area Design:** Terminal area elements and requirements, terminal building functions, space requirements, location planning concepts, vehicular parking area and Circulation network. passenger requirements at terminal building	**4**	**5**
6	**Grading and Drainage :** Airport grading-importance - operations, airport drainage aims, functions, special characteristics, basic requirements, surface and subsurface Drainage systems.	**2**	**5**
7	**Air Traffic Control and Visual Aids:** Air traffic control-objectives, control system, control network-visual aids-landing information system, airport markings and lighting.	**2**	**5**

Reference Books:

1. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros.,Roorkee
2. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi
3. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand
4. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, DhanpatRai& Sons, NewDelhi
5. Airport Engineering, Charotar Publishing House Pvt. Ltd, Anand

COURSE OUTCOMES:

After completing the course, the students will be able to:

2180602.1 **Explain** various components of harbour and airport.
2180602.2 **Understand** the fundamentals of planning and design of harbour and airport.
2180602.3 **Discuss** the importance of natural phenomena for harbour operation, function and types of various marine structures.
2180602.4 **Illustrate** the different techniques for harbour repair and maintenance.
2180602.5 **Describe** the various design aspects of runway, taxiway and terminal area.
2180602.6 **Summarize** the importance and function of airport grading and drainage, and the operation of air traffic movements at airport with its control.

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES												PSOs				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**
2180602.1	3	-	-	-	-	-	1	-	-	-	-	2	3	-	-	-	-
2180602.2	3	-	-	2	-	-	2	-	-	-	-	2	3	-	1	1	-
2180602.3	2	-	-	-	-	2	1	-	-	-	-	2	3	-	-	-	-
2180602.4	2	-	-	2	-	2	-	-	-	-	-	2	2	-	1	-	2
2180602.5	3	2	3	-	2	-	-	-	-	-	-	3	3	2	-	2	-
2180602.6	2	2	2	-	2	-	2	-	-	-	-	2	2	2	-	-	-
2180602	**2.5**	**2**	**2.5**	**2**	**2**	**2**	**1.5**	**-**	**-**	**-**	**-**	**2.17**	**2.67**	**2**	**1**	**1.5**	**2**

3: Strong 2: Moderate 1: Low - : NA

CO-PO MAPPING & JUSTIFICATION:

Mapping	Level	Justification
2180602.1-PO1	3	Acquired Basic knowledge of various elements of Harbour and Airport and apply for engineering fundamental.
2180602.1-PO7	1	Understand the impact of the professional engineering solutions in societal and environmentalfor various elements of Harbour and Airport.
2180602.1-PO12	2	Recognize the need of various elements of Harbour and Airport to development of technological aspects.
2180602.2-PO1	3	Apply the engineering knowledge of fundamentals of planning and design of harbour and airport to solve the problems.
2180602.2-PO4	2	Conduct investigation for the planning a new harbour or airport, also for the improvement of existing one.
2180602.2-PO7	2	Proper planning and design of terminal facility is required for environmental aspects and also for the sustainable infrastructure development.
2180602.2-PO12	2	Develop the ability to engage in the task of planning and design of airport and harbour.

2180602.3-PO1	2	Apply the engineering fundamentals to understand the natural phenomena for harbour operations and also air traffic movements.
2180602.3-PO6	2	Responsibilities relevant to the professional engineering practice for the operations in Harbour.
2180602.3-PO7	1	Understand the impact of the professional engineering solutions in societal and environmental for design of various marine structures.
2180602.3-PO12	2	Develop the ability to engage independent and lifelong learning of technological change of various types of marine structures.
2180602.4-PO1	3	Basic knowledge of maintenance techniques at Harbour and airport. Apply appropriate techniques, resources, and modern engineering maintenance techniques at Harbour.
2180602.4-PO4	2	Conduct investigation for the solution generation of complex problem for harbour repair and maintenance.
2180602.4-PO6	2	Understand the impact of the professional engineering solutions in societal and environmental point of view for the maintenance techniques at Harbour.
2180602.4-PO12	2	Develop the ability to work as independent entrepreneur to make some changes in technological aspects of maintenance techniques.
2180602.5-PO1	3	Basic knowledge of planning and design of various facility required at the airport e.g. runway, taxiway terminal area etc.
2180602.5-PO2	3	Identify and Analyse complex engineering problems and feasible solutions in design approach of various elements.
2180602.5-PO3	3	Conduct investigations using research based knowledge and methods. Also carry out analysis and interpretation of data to provide a valid conclusion.
2180602.5-PO5	2	Select and apply appropriate modern techniques, tools and modern engineering for planning and design of Airport.
2180602.5-PO12	3	To engage in independent and life-long learning, planning and design of Airport.
2180602.6-PO1	2	Apply knowledge of engineering fundamentals and an engineering specialization to the solution of problems of airport grading and drainage which are of more significant during monsoon and for safe operation of aircrafts.
2180602.6-PO2	2	Identify the actual problems of grading and drainage and formulate them with the review research carried out.
2180602.6-PO3	2	Develop the alternate feasible plans or solutions to overcome the drainage problem, during emergency backup plan should be available for safe and efficient air traffic movement.
2180602.6-PO5	2	Select and apply appropriate techniques, resources and modern technologies for the prediction of problem is required as a safety point of view on the runway or in the air movement.
2180602.6-PO7	2	While planning and designing of airport terminal facilities, it should be clearly understood the environmental degradation and impact of such on the environment for sustainable development.
2180602.6-PO12	2	One can persist the career in the maintenance of drainage and ability to engage in lifelong learning in context of technological change.

CO-PSO MAPPING & JUSTIFICATION:

Mapping	Level	Justification
2180602.1-PSO1	3	Apply the technical knowledge to understand the various components of harbour and airport.
2180602.2-PSO1	3	Engineers can actively apply the technical knowledge and skill by understanding the fundamental planning and design of harbour and airport to solve engineering problems.
2180602.2-PSO3	1	Graduates will be able to provide the environmental friendly sustainable solutions while planning and design of harbour and airport facility.
2180602.2-PSO4	1	Achieve expertise in design and analysis of planning and design of various components of harbour and airport by understanding the fundamentals engineering.
2180602.3-PSO1	3	Discuss the importance of natural phenomena for safe, efficient harbour operation and apply technical knowledge and skill for solving civil engineering problems.
2180602.4-PSO1	2	Apply technical skill to solve the problems of repair and maintenance using modern methods, tools or techniques.
2180602.4-PSO3	1	Become responsible technocrats using different techniques which would be environmental friendly.
2180602.4-PSO5	2	Develop the career as professional entrepreneur for repair and maintenance activities of harbour.
2180602.5-PSO1	3	Apply the knowledge and skill to understand the various of runway, taxiway and terminal area design to solve the design related problems occurred.
2180602.5-PSO2	2	Graduates can achieve expertise in design and analysis of airport structure and other terminal facilities.
2180602.5-PSO4	2	Become capable of design functionally efficient structures of airport terminals, runways, taxiway etc. Knowing the latest development in the field of civil aviation.
2180602.6-PSO1	2	Summarize the significance of airport gradient and drainage to apply their technical knowledge and skill to solve the drainage related issues to cover periodic maintenance of runway, taxiway etc.
2180602.6-PSO2	2	Civil Engineer can develop their career as professional entrepreneur to work with civil maintenance engineer by using knowledge and technical skills.

Programme: Civil Engineering	**Degree: B.E.**
Course Code: 2180605 Project-II	**Semester: 8**
Credits: 8	**Contact hours: 8 hours (Practical)**

After completing the course, the students will be able to:

2180605.1 **Demonstrate** initiative and intellectual levels to comprehend the chosen topic.
2180605.2 **Search** for technical information from various resources, such as the library, research and technical literature, electronic database and the World Wide Web.
2180605.3 **Formulate** engineering problems and develop appropriate solution methods.
2180605.4 **Understand** and demonstrate the required professionalism to influence the societal change.
2180605.5 **Write** scientific report and present their research work in a precise and coherent manner.

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES												PSOs				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**
2180605.1	3	-	-	2	-	-	-	-	-	-	-	2	2	-	-	-	2
2180605.2	3	3	-	3	3	-	-	-	-	-	-	-	2	2	-	-	-
2180605.3	2	3	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
2180605.4	3	-	3	-	-	2	2	-	-	-	-	-	2	-	-	2	-
2180605.5	3	2	-	-	2	-	-	-	2	2	-	2	2	-	-	-	2
2180605	**2.8**	**2.67**	**2.5**	**2.33**	**2.33**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**2**	**2**	**2**	**2**

3: Strong 2: Moderate 1: Low -:NA

CO-PO MAPPING & JUSTIFICATION:

Mapping	Level	Justification
2180605.1-PO1	3	Acquire the basic knowledge of science and engineering fundamental to Demonstrate the initiative and intellectual levels to comprehend the chosen topic of IDP/UDP.
2180605.1-PO4	2	In order to Demonstrate the problem they can identify the problems in either in industry or develop the new concept under IDP or UDP.
2180605.1-PO12	2	By doing hands on practice of their project related work they can recognize the need and develop the ability to do the task to solve industrial or real life problems and make the change in technological aspects involved.
2180605.2-PO1	3	They can search for technical information from various resources, such as the library, research and technical literature, electronic database and the World Wide Web.
2180605.2-PO2	3	Able to identify the problems similar to the situation after searching from various resources and formulate them by review of research papers and literature review.
2180605.2-PO4	3	They can conduct the investigations based on knowledge and research methods from earlier studies to develop new feasible solutions.
2180605.2-PO5	3	To derive the alternate feasible solutions, they can select and apply appropriate techniques, resources and modern engineering tools including data analysis and software to make suitable conclusions.
2180605.3-PO1	2	They can apply the knowledge of engineering fundamentals, science and mathematics to generate appropriate solution methods.
2180605.3-PO2	3	Identify and analyse the problems based on review of research papers and literature studies carried out.
2180605.3-PO3	2	Formulate engineering problems and develop appropriate solution methods for designing solutions for complex engineering problems.
2180605.3-PO4	2	Conduct the investigations by experiments and studies based on review and carry out analysis to find the solutions of problems.
2180605.3-PO5	2	They can prepare, select and apply the appropriate methods using IT tools and software to develop the solutions.
2180605.4-PO1	3	Understand and demonstrate the required professionalism to influence the societal change by giving the new techniques or solutions to the specific problem of industries or society.

2180605.4-PO3	3	They design the new improved techniques and tools for required professionalism to influence the societal change.
2180605.4-PO6	2	By implementing new techniques to solve the problems they can apply the changes to their professionalism to influence the societal change.
2180605.4-PO7	2	They can develop the new tools by keeping the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge for sustainable development.
2180605.5-PO1	3	Applying the basic knowledge of fundamental of engineering they will be able to write the project report and present their research work in a precise and coherent manner.
2180605.5-PO2	2	They can also analysis the problem and mention in their report and carry out the research proposed to develop the solutions or conclusions.
2180605.5-PO5	2	By using modern tool they can adopt their results based on software and data analysis in the scientific report and present their research work in a precise and coherent manner.
2180605.5-PO9	2	They can write the project report as an individual and as a member or leader to carry out their research work and present in their reports.
2180605.5-PO10	2	They can develop their communication skill and writing proficiency skill to make scientific report.

CO-PSO MAPPING & JUSTIFICATION

Mapping	Level	Justification
2180605.1-PSO1	2	Students can apply technical knowledge and skill to demonstrate initiative and intellectual levels to comprehend the chosen topic
2180605.1-PSO5	2	Graduates can pursue their career as professional engineer by using knowledge and skills by their research work to start-up as an entrepreneur.
2180605.2-PSO1	2	They can apply their knowledge and skill for solving civil engineering related problems of industries and society by searching and gathering technical information from various resources, such as the library, research and technical literature, electronic database and the World Wide Web.

2180605.2-PSO2	2	Define the problem statement and based on that to solve the problem they can search the resources and carry out the analysis work by suing appropriate methods or techniques.
2180605.3-PSO1	2	They can apply basic knowledge of fundamental engineering to formulate engineering problems and develop appropriate solution methods.
2180605.3-PSO2	2	Students can design and carry out the analysis of structure by modern civil engineering tools.
2180605.3-PSO3	2	Graduates can Formulate engineering problems and develop appropriate solution methods and become responsible technocrats to deliver environmental friendly sustainable solutions.
2180605.4-PSO1	2	They can apply the basic skill and knowledge to understand and demonstrate the required professionalism to influence the societal change.
2180605.4-PSO4	2	Students can understand and demonstrate the required professionalism to influence the societal change in the design functionally efficient structures knowing the latest development in the field of civil engineering.
2180605.5-PSO1	2	Graduates will be able to write scientific report and present their research work in a precise and coherent manner based on their technical knowledge and skill to solve civil engineering problems of industries and society.
2180605.5-PSO5	2	They can develop their career as professional entrepreneur by using their knowledge and soft skills in writing technical report and present their research work in a practice to the innovation.

GUJARAT TECHNOLOGICAL UNIVERSITY
CIVIL ENGINEERING
REPAIRS AND REHABILITATION OF CONCRETE STRUCTURES
SUBJECT CODE: 2180607
B.E 8th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Scheme						
				Theory Marks			Practical Marks			Total Marks
					PA(M)		PA(V)			
L	T	P		EAE (E)	PA	ALA	ESE	OEP	PA (I)	
3	1	0	4	70	20	10	30	0	20	150

Syllabus:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction:** Overview of distress, deterioreation in concrete structures, Scenario of distressed structures world over, need for reoairs and upgrading of structures, General introduction to process (Road-map) to a durable concrete repair.	04	05
2	**Deterioration of Concrete Structures:** Types of deterioration**:** Signs, causes & symptoms, Mechanism of deterioration, contributing factors like permeability, inadequate durability & micro-structure of concrete. Physical deterioration due to moisture, temperature, shrinkage, freeze-thaw, abrasion, erosion, cavitation, crystallization of salts, Efflorescence, exposure to severe environment like marine exposure. Chemical deterioration due to corrosion of reinforcement (chloride induced, carbonation induced), Alkali-silica reaction, sulphate attack, Acid attack **Deterioration due to water leakage, fire** – detection & mitigation of the same. Deterioration due to ageing, inadequate maintenance, Design & construction deficiencies, overloading etc. **Visual deterioration of structures-** Types of cracks, causes & characteristics of cracking in various structural components like beam, column, slab, masonry walls. Measurement of cracks, interpretation of the cause of particular type of crack.	10	25
3	**Conditional/damage assessment & Evaluation of structures:** **Structural assessment:** Conditional evaluation / Structural Appraisal of the structure – Importance, objective & stages, Conditional/damage assessment procedure, Preliminary & Detailed investigation – Scope, Objectives, Methodology & Rapid visual inspection of structures **Damage Assessment allied Tests (Destructive, Semi-destructive, Non-destructive):** Field & laboratory testing procedures for evaluating the structure for strength, corrosion activity, performance & integrity, durability. Interpretation of the findings of the tests	10	25

	Repair materials - Criteria for durable concrete repair, Methodology, performance requirements, repair options, selection of repair materials, Preparatory stage of repairs, Different types of repair materials & their application, types of repair techniques. **Retrofitting/Strengthening:** Need for retrofitting, Design philosophy of strengthening structures, Techniques available for strengthening including conventional and advanced techniques. **Seismic retrofit of concrete structures :**Deficiencies in structure requiring seismic retrofit, Design philosophy, Techniques to enhance the seismic resistance of structures, advanced techniques for making seismic resistant structures emperature, shrinkage, freeze-thaw, abrasion, erosion, cavitation, crystallization of salts, Efflorescence, exposure to severe environment like marine exposure. Chemical deterioration due to corrosion of reinforcement (chloride induced, carbonation induced), Alkali-silica reaction, sulphate attack, Acid attack.	12	25
6	**Allied Topics:** **Protection & maintenance of structures -** Importance of protection & maintenance, Categories of maintenance, Building maintenance. Corrosion mitigation techniques to protect the structure from corrosion. **Long term health monitoring / Structural health monitoring (SHM)–** Definition and motivation for SHM, Basic components of SHM and its working mechanism, SHM as a tool for proactive maintenance of structures.	06	15

Reference Books:

1. Concrete microstructure, Properties and materials – P Kumar Mehta and Paulo J.M.Monterio
2. Handbook on Repairs and Rehabilitation of RCC buildings – CPWD, Government of India.
3. Concrete technology – A.R.Shanthakumar, Oxford University Press, India
4. Concrete Technology by M.L.Gambhir, Tata McGraw-Hill Education, Third Edition
5. Appraisal and Repair of Reinforced concrete by R.Holland, Thomas Telford Ltd. London.
6. J.H.Bungey, S.G.Millard & M.G.Grantham , Testing of Concrete in Structures, 4th Edition, Taylor & Francis, London & New York, 2006.
7. V. M. Malhotra, Nicholas J. Carino 2004 “Handbook on Nondestructive Testing of Concrete”
8. “Repair and Strengthening of Concrete structures” , FIP guide, Thomas Telford, London.
9. Concrete Structures, Protection, Repair and Rehabilitation by R.Dodge Woodson.
10. Structural Condition assessment by Robert T. Ratay.
11. Repairs and rehabilitation of concrete structures by P. I. Modi & C. N. Patel, PHI Publication.

Course outcomes:

After completion of this course, students will be able to:

1. **define** the terminolgy of distress in concrete, repiring, rehabilitation and long term health monitoring of structures and to some extent be able to **compare** the various NDT methods, repairing materials and techniques used.
2. **analyze** the deterioration of structure by evaluating the condition assesment of structures. Students can **understand** the significance of protection and maintenance of structures.
3. **reconstruct** the structures using knowledge of repairing, retroffiting and rehabilitation techniques.
4. **apply** the knowledge, techniques, skills and modern tools to become successful professionals in repairing, retrofffiting and rehabitation of structurers as well as in health monitoring of structures.

PSO-Program Specific Outcomes:

1. Educating students with fundamental and technical knowledge for actively apply to solve day-to-day societal problems related to the field of civil engineering.

2. Motivate to engage them for achieving expertise in design and analysis of structures by modern civil engineering tools.

3. Cultivate skills for continuous learning to achieve functionally efficient, costeffective and safe solutions of modern infrastructure development.

4. Inculcate students to develop professional skills, abilities and attitude for wage employment and/or to become entrepreneur.

5. Inspiring Students to become ethically responsible technocrats to deliver environmental friendly and sustainable solutions.

CO-PO mapping

	PROGRAM OUTCOMES												**PSOs**				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2180607.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2180607.2	3	3	2	-	3	2	-	-	-	-	-	-	2	2	-	2	-
2180607.3	2	3	3	-	3	3	2	-	1	-	-	-	2	2		3	3
2180607.4	3	2	-	-	3	-	-	2	2	-	-	1	-		-		3
2180607	3.0	3.0	3.0		3	3.0	2	2	2			1	2	2	-	3.0	3

3: Strong 2: Moderate 1: Low -:NA

Mapping & Justification

Mapping	Level	Justification
CO1-PO		
2180607.1-PO1	3	Basic knowledge of deterioration of structures and repairing materials and techniques can be apply effectively.
2180607.1-PO2	2	Concepts and techniques learn in this subject can be applied to analyze the deterioration and evaluation of condition assessment of structures.
CO2-PO		
2180607.2-PO1	3	The fundamental knowledge about repairing techniqes and helth monitoring of structures will further be utilized in analysis of damaged stucture and repairing work plan.
2180607.2-PO2	3	Students will be able to differentiate various techniqures and they can analyzethe need of particular technique in a specified situation.
2180607.2-PO3	2	Students can apply the data of analysis during damage assessment to desin the repairing and retroffiting of structures.
2180607.2-PO5	3	Students use various repairing techniques in their project and laboratory work. They can also use the virtual laboratory to understand the working principles of techniques. s. So, they will be acquainted with latest tools and techniques.
2180607.2-PO6	2	Structural health monitoring knowledge can be apply to health and safety of society. Thus students can be responsible to use their knowledge in profesional engineering practice.
C03-PO		
2180607.3-PO1	2	Aplly the knowledgeof requirement of repairing and health monitoring.
2180697.3-PO2	3	Students will be able to analyze and identify the techniques required for particular problem.
2180607.3-PO3	3	Students will be able to apply learned techniques in the design and reconstruction and retrofitting of structures.
2180607.3-PO5	3	Students can use the modern repairing techniques to solve the problems of damaged structures.
2180607.3-PO6	3	Structural health monitoring knowledge can be apply to health and safety of society. Thus students can be responsible to use their knowledge in profesional engineering practice by repairing and retroffing the structures.
2180607.3-PO7	2	Reconstruct, repairing and rehabilitation of structues increases the sustanability of concrete industry.
2180607.3-P09	1	A mini project will impart team work skills.
CO4-PO		
2180607.4-PO1	3	Knowledge about repairs materials and techniques and helth monitoring assessment can further be utilized for advising and repairing of damaged structures.
2180607.4-PO2	2	Identify and analyze the problem in existing structure as a professional.
2180607.4-PO5	3	Can use modern techniques in their constructional profession for repairing and retroffiting of structures.
2180607.4-PO8	2	Can apply the ethics in thier profession by un derstanding the necessity of damage assessment and repairs required for helth and safety of society.
2180607.4-P09	2	Impart team work
2180607.4-PO12	1	Students can engage independent and life-long learning in the

		contex of technological change.

CO-PSO Mapping & Justification

2180607.1-PSO1	2	Basic knowledge of deterioration of structures and repairing materials and techniques can be applied to solve real life problems.
2180607.2-PSO1	2	Students can analyze the condition assessment of civil engineering structures for repairing and retrofitting for maintenance.
2180697.2-PSO2	2	Students can use the recent methods and techniques to analze the structutes.
2180607.2-PSO4	2	Knowledge of diagnosis of problem in existing structure develops professional skill and abilities.
2180607.3-PSO1	2	Students can reconstruct the structures by using the various techniques of repairing, retrofitting and rehabilitation of structures.
2180697.3-PSO2	2	The case study of real life structures motivate students to use new techniques and tools for the diagnosis and maintenance of structures.
2180607.3-PSO4	3	Knowledge of various techniques for the maintenance and retroffiting of structures develops professional skills, abilities and attitude to start own consultancy.
2180607.3-PSO5	3	The knowledge of importance of protection and maintenance of structures make students responsible to understand the impact of ethical professional practice in social and environmental contexts.
2180607-4-PSO4	3	Knowledge of use of techniques of repairing and retrofitting of structures develops responsibility to give ethical and sustainable solutions of structures

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING
SUBJECT NAME: FOUNDATION ENGINEERING
SUBJECT CODE: 2180609
B.E. 8th SEMESTER

Teaching and Examination Scheme

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

1	Selection of foundation and Sub-soil exploration/investigation: Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation based on soil condition, Objectives and planning of exploration program, methods of exploration-wash boring and rotary drilling-depth of boring, soil samples and soil samplers-representative and undisturbed sampling, field penetration tests: SPT, SCPT, DCPT. Introduction to geophysical methods, Bore log and report writing, data interpretation.
2	Shallow Foundation: Introduction, significant depth, design criteria, modes of shear failures. Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, Proportioning of footing for equal settlement, allowable bearing pressure. Bearing capacity from in-situ tests(SPT, SCPT, PLATE LOAD), Factors affecting bearing capacity including Water Table., Bearing capacity of raft/mat foundation as per codal provisions, Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design.
3	Pile foundations : Introduction, load transfer mechanism, types of piles and their function, factors influencing selection of pile, their method of installation and their load carrying characteristics for cohesive and granular soils, piles subjected to vertical loads- pile load carrying capacity from static formula,dynamic formulae (ENR and Hiley), penetration test data & Pile load test (IS 2911). Pile group: carrying capacity, efficiency and settlement. Negative skin friction
4	Foundations on problematic soil & Introduction to Geosynthetics : Significant characteristics of expansive soil, footing on such soils, Problems and preventive measures. Under-reamed pile foundation-its concept,design & field installation. Significant characteristics of silt and loess, problems & remedial

	measures footing on such soils, introduction to geosynthetics-types and uses.
5	Retaining walls : Types (types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging).

Reference Books:

1) P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson Education.
2) B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd., Delhi.
3) Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
4) Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
5) V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical Consultants, Banglore
6) Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.
7) Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
8) Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.

IS Codes :

9) 1. Code of practice for determination of bearing capacity of shallow foundation IS:6403
10) 2. Code of practice for design and construction of pile foundation- IS:2911 (Part I to IV)
11) 3. Method for standard penetration test for soil- IS:2131
12) 4. Code of practice for subsurface investigation for foundation- IS:1892
13) 5. Code of practice for structural safety of buildings: Shallow Foundations- IS:1904
14) 6. Code of practice for calculation of settlement of foundations- IS:8009

Course outcomes:

After learning the course, the student should be able to:

1. **Explain** appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per codal guidelines.
2. **Discuss** appropriate/suitable foundation system (shallow/Deep) for different structures, that satisfy the allowable bearing capacity and settlement requirements based on soil properties
3. **Differentiate** the engineering behaviour of expansive soils and selection of suitable foundation type for such soils.
4. **Judge** use of alternate materials like geosynthetics and its application in foundation problems.

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2180609.1	3	2	1	3	-	-	-	-	2	-	-	3	1	-	-	2	2
2180609.2	3	2	3	-	-	-	-	-	2	2	-	2	2	-	-	2	2
2180609.3	3	2	3	2	-	-	-	-	-	-	-	-	2	-	-	2	2

2180609.4	3	-	3	-	-	-	1	-	1	2	-	-	-	-	-	2	2
2180609	3	2	3	3	-	-	1	-	2	2	-	2	1	-	-	2	2

3: Strong 2: Moderate 1: Low -:NA

Mapping	Level	Justification
2180609.1-PO1	3	Engineering knowledge of the students will be enhanced by learning different methods for soil investigation and understanding the importance of various parameters.
2180609.2-PO1	3	Different types foundation systems are introduced that will enhance their skills regarding structural foundations for different types of soils.
2180609.3-PO1	3	Knowledge about the behaviour of expansive soil will help students decide the suitable foundation for the soil type.
2180609.4-PO1	3	Geo synthetic materials and its application in foundation engineering will increase the student's understanding about other than conventional solutions in foundation engineering.
2180609.1-PO2	2	Indentifying the correct value of the sub soil parameters will help students in problems analysis for the foundation selection.
2180609.2-PO2	2	Knowledge of allowable bearing capacity and settlement requirements for different foundation systems will help students to analyse the problems in foundations.
2180609.3-PO2	2	Understanding the behaviour of expansive soil is important for identifying the problems for this particular soil type.
2180609.1-PO3	1	Use of appropriate soil testing technique and true sub soil parameters is essential for the selection and design of suitable foundation system.
2180609.2-PO3	3	Understanding of suitable foundation system (shallow/Deep) for different structures is primary requirement for the development of the solutions regarding the design of foundation.
2180609.3-PO3	3	Knowledge about the behaviour of expansive soil will help students decide the suitable foundation for the soil type.
2180609.4-PO3	3	use of alternate materials like geosynthetics help to design solution with the environmental consideration.
2180609.1-PO4	3	Knowledge of appropriate soil testing technique and true sub soil parameters will help students to conduction investigation for complex problems.
2180609.3-PO4	2	Knowledge about the behaviour of expansive soil will help students to analyse the data of soil testing and decide the suitable foundation for the soil type.
2180609.4-PO7	1	use of alternate materials like geosynthetics help to design solution with the environmental consideration.
2180609.1-PO9	2	To find the sub soil parameters tests will be conducted it will increase the ability of students to work in team.
2180609.2-PO9	2	Students will be able to discuss the various types of foundation systems for different soil types in group.
2180609.4-PO9	1	Students will be able to judge the use of alternative materials like geosynthetics individually.
2180609.2-PO10	2	Students will be able to discuss and present various types of foundation

		systems for different soil types that will increase the soft skills.
2180609.4-PO10	1	Students will be able to present the use of alternative materials like geosynthetics and its applications.
2180609.1-PO12	3	Students will able to use codes of provisions for the various soil investigation methods and conduct tests on their own for the field as professionals.
2180609.2-PO12	2	Students will be able to design foundations for different structures.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING
SUBJECT NAME: DESIGN OF STEEL STRUCTURES
SUBJECT CODE: 2180610
B.E. SEMESTER-VIII

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	0	5	70	20	10	30	0	20	150

ESE-End Semester Exam, PA-Progressive Assessment, E-External, M-Mid semester, V-Viva (External) , I-Internal, ALA-Active Learning Assignment, OEP-Open Ended Problem

Syllabus:

1	Loads & Load Combinations: Appraisal of loading standards such as I.S, I.R.C., Effect of wind and earthquake on structure
2	Connections: Stiffened and unstiffened, moment & shear resisting structural connections, design and detailing of various connection - roof truss to column, column to beam, beam to beam and truss to bed block
3	Design of Industrial Building: Structural layout of industrial building, Various types of trusses and their selection, effect of wind loads on purlin and trusses, bracing systems, columns, foundations, gantry girder – static and moving loads, selection & design of section.
4	Design of plate girders: Modes of failure : Elastic buckling, Bending in the plane of web, Local buckling, Buckling in the plane of web, Vertical buckling of the compression flange, Shear buckling Design of bolted, welded plate girder by Tension field Method & Simple Post Critical Method including design of vertical & horizontal stiffeners, Splices,curtailment
5	Design of foot-over bridges: Structural system of through & deck type bridges, design of foot-over bridge & its Supporting system
6	Plastic Design: Introduction to plastic method of analysis, Design of continuous beams and portal frame using plastic design approach.

Reference Books:

1. N. Subramaniam, Design of Steel Structures, Oxford University Press
2. S. S. Bhavikatti, Design of Steel Structures: By Limit State Method as Per IS: 800-2007, I K International Publishing House Pvt. Ltd
3. P. Dayaratnam, "Design of Steel Structures", S. Chand Group

4. IS 800:2007, General Construction In Steel - Code of Practice, Bureau of Indian Standards, New Delhi.
5. IS 875 (Part 1): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 1 Dead Loads - Unit Weights of Building Materials and Stored Materials, Bureau of Indian Standards, New Delhi.
6. IS 875 (Part 2): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 2 Imposed Loads, Bureau of Indian Standards, New Delhi.
7. IS 875 (Part 3): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 3 Wind Loads, Bureau of Indian Standards, New Delhi.
8. IS 875 (Part 4): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 4 Snow Loads, Bureau of Indian Standards, New Delhi.
9. IS 875 (Part 5): latest version, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures Part 5 Special Loads and Combinations, Bureau of Indian Standards, New Delhi.

Course outcomes:

After learning the course, the students should be able to:

1**. plan** structural layout of Industrial steel structures, plate girder, foot-over bridge.

2. **Evaluate** the loads acting on it and identify the typical failure modes.

3. **Relate** the principles, procedures and current Indian codal provisions to calculate and design of Industrial structures, plate girder & foot-over bridges.

4. **Apply** the principles of plastic design in steel beams & portal frames

PSOs-Program Specific Outcomes

PSO 1. Educating students with fundamental and technical knowledge for actively apply to solve day-to-day societal problems related to the field of civil engineering.

PSO 2. Motivate to engage them for achieving expertise in design and analysis of structures by modern civil engineering tools.

PSO 3. Cultivate skills for continuous learning to achieve functionally efficient, cost effective and safe solutions of modern infrastructure development.

PSO 4. Inculcate students to develop professional skills, abilities and attitude for wage employment and/or to become entrepreneur.

PSO 5. Inspiring Students to become ethically responsible technocrats to deliver environmental friendly and sustainable solutions

CO-PO mapping

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2180610.1	1	1	3	1	3	1	2	1	1	1	1	1	3	3	3		3
2180610.2	3	2	3	3	3	3	2	-	2	1	1	1	3	3	2		3
2180610.3	2	3	3	3	3	3	3	2	2	3	3	3	2	3	3		3
2180610.4	3	3	-	-	-	2	2	-	-	-	-	-	-	1	1		3
2180610	2	2	3	2	3	2	2	2	2	2	2	2	3	3	2		3

3: Strong 2: Moderate 1: Low -:NA

Mapping	Level	Justification
2180610.1-PO1	1	Will be able to apply knowledge of geometry to draw sketch .
2180610.1-PO2	1	Will be able to identify, practice difficulties while preparing engineering sketches.
2180610.1-PO3	3	Will be able to consider aspect of safety and health while preparing structural drawing
2180610.1-PO4	1	Will be able to apply knowledge of geometry to draw sketch .
2180610.1-PO5	3	AutoCAD,Revit are the softwares will be used by students to prepare structural drawing.
2180610.1-PO6	1	Will be able to apply knowledge of geometry to draw sketch .
2180610.1-PO7	2	Will be able to draw different options of the structure and can finalise the best suitable option based on suitability of environment, economy and society.
2180610.1-PO8	1	Will be able to understand and apply government norms to plan and draw structural layout.
2180610.1-PO9	1	Students will be able to work in a team to draw different layout including electrification and plumbing.
2180610.1-PO10	1	Will be able to communicate to other departments working on the same project.
2180610.1-PO11	1	Will be able to understand project cost will be affected by improper position of structural layout .
2180610.1-PO12	1	Will be in lifelong learning process by getting experience of drawing different layouts and drawings.
2180610.2-PO1	3	Will be able to judge failure mode and load for assessment by using

		engineering fundamentals.
2180610.2-PO2	2	Determination of critical load on structure involves review and critical understanding of codal provision to analyse the structure.
2180610.2-PO3	3	Will learn to calculate loads acting on structure which meets the specified needs , will be able to judge failure mode which plays vital role in safety of society .
2180610.2-PO4	3	Will be able to analyse and interpret the data to find out design load
2180610.2-PO5	3	Will be able to analyse structure by applying different technique as well different software like STAAD.Pro etc. As well he/she will be able to apply criteria for design.
2180610.2-PO6	3	Will be able to calculate loads on structure considering safety and serviceability criteria.
2180610.2-PO7	2	Determination of load and calculation imparts the knowledge and understanding of sustainable developments.
2180610.2-PO9	2	Calculation of forces for huge structures involves team work and coordination.
2180610.2-PO10	1	Calculation of loading involves communication with client about the machine to be installed or the purpose for which steel structure is designed .
2180610.2-PO11	1	Will be able to pursue Loading calculation changes the design and so the size of section and directly affects the finance.
2180610.2-PO12	1	Load calculation with development and new technological advances imparts constant learning.
2180610.3-PO1	2	Knowledge of mathematics and engineering fundamentals will be applied to analyse the structure.
2180610.3-PO2	3	Students will be able to analyse as well review and decide appropriate equation.
2180610.3-PO3	3	Analysis and design of complex steel and rcc structure needs appropriate consideration to design safe, serviceable and sustainable structure .
2180610.3-PO4	3	Application of codal provision for design and analysis involves interpretation of complex information and data .
2180610.3-PO5	3	Students will be able to carry out use of different softwares to analyse and design the structure.
2180610.3-PO6	3	By understanding the importance of safe and serviceable design, students will be apply to knowledge to professional engineering

		practice.
2180610.3-PO7	3	Safe, serviceable and sustainable structure design of steel structures plays an important role environmentally.
2180610.3-PO8	2	Will be able to apply proper codal provision to make safe structure to perform responsibilities and norms of the engineering practice.
2180610.3-PO9	2	Design a whole structure is multidisciplinary work depending upon structure will lead student to work in team .
2180610.3-PO10	3	Design a whole structure is multidisciplinary work depending upon structure will lead student to work in team and effective communication smoothens the process of structural design .
2180610.3-PO11	3	Finance of the project work and management mainly depends on the design of structure and estimation based on design of structure so knowledge of subject will help .
2180610.3-PO12	3	Design different kind of structure with small variety brings knowledge will impart lifelong learning process.
2180610.4-PO1	3	Will be able to identify, practice difficulties while designing economical structure by using plastic design methodology.
2180610.4-PO2	3	Will be able to analyse structure, apply proper codal provision to make safe structure by using plastic design method.
2180610.4-PO6	2	Will be able to draw different options of the structure and can finalise the best suitable option based on suitability of environment, economy and society.
2180610.4-PO7	2	Will be able to draw different options of the structure and can finalise the best suitable option based on suitability of environment, economy and society.
2180610.1-PSO1	3	will be able to prepare structural lay outs of various structures in the field.
2180610.2-PSO1	3	Will be able to calculate loads in acting on the structures and find the possible failure mode of the structures.
2180610.3-PSO1	2	Will be able to use IS codes provisions to design steel structures like plate girders, foot over bridges, gantry girders , industrial buildings etc.
2180610.1-PSO2	3	will be able to prepare structural lay outs of various structures in the field.
2180610.2-PSO2	3	Will be able to calculate loads in acting on the structures and find the possible failure mode of the structures.

2180610.3-PSO2	3	Will be able to use IS codes provisions to design steel structures like plate girders, foot over bridges, gantry girders , industrial buildings etc.
2180610.4-PSO2	1	Will be able to apply plastic analysis and design concepts in cases of beams and frames.
2180610.1-PSO3	3	Will be able to plan functionally efficient structural layouts for various structures.
2180610.2-PSO3	2	Will be able to accurately evaluate loading conditions to design safe structures.
2180610.3-PSO3	3	Will be able to use codal provisions, design principles to make structure cost effective, safe and functionally efficient.
2180610.4-PSO3	1	Will be able to provide plastic design for beam and frame which is economical compare to limit state or working stress design methods.
2180610.1-PSO5	3	Will be able to plan Structural layouts, evaluate loading condition and failure mode and design structures using codal provisions and design principles ethically.
2180610.2-PSO5	3	
2180610.3-PSO5	3	
2180610.4-PSO5	3	

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING
SUBJECT NAME: CONSTRUCTION MANAGEMENT
SUBJECT CODE: 2180611
B.E. 8th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	2	-	5	70	20	10	30	0	20	150

SYLLABUS:

Sr. No.	Contents	Total Hrs.	% Weightage
1	**Introduction:** A construction project, Phases of construction project, Importance of construction and construction industry, Indian construction industry need of construction management, Stakeholders of construction management.	**3**	**5**
2	**Project organization**: Construction company structure of construction organization, Organizing for construction project management, Management levels, Traits of project manager and co-coordinators. Ethical conduct for engineers, Factors for success of a construction organization.	**2**	**5**
3	**Construction economics:** Economic decision making, Evaluating alternatives by , Effect of taxation on comparison of alternatives, Effect of inflation on cash flow, Evaluation of public projects, Benefit cost ratio method.	**4**	**10**
4	**Construction planning:** Types of project plans, Work break down structure, Planning techniques, Bar charts, CPM and PERT network analysis, Precedence network ladder network, Line of balance method.	**4**	**10**
5	**Project scheduling and Resource leveling**, Resource allocation, Importance of project scheduling, Deriving other schedules, Network crushing and cost time trade off.	**4**	**10**
6	**Construction equipment management** advanced concepts in economical analysis.	**3**	**5**
7	**Construction accounts management** Principles of accounting, Accounting process construction contract revenue recognition, and Construction contract status report, Limitation of accounting, Balance sheet, Profit and loss account, Working capital, Ratio analysis, and Fund flow statement.	**4**	**10**
8	**Construction material management**: Material management functions, Inventory management. Job layout	**2**	**5**
9	**Construction project cost and cost and value managements** – Project cost management, Collection of cost related information, Cost codes, Cost statement, Value management in construction, Steps, Value engineering application in a typical case project.	**4**	**10**
10	**Construction quality management:** Construction quality, Inspection, Quality control and Quality assurance in projects, Total quality management, Quality gurus and their teaching cost of quality	**4**	**10**

	ISO standards, Principles of quality management systems, (CONQUAS) construction quality assessment system.		
11	**Construction safety management**, Evolution of safety, Accident causation theory, Unsafe conditions, Unsafe acts health and safety act and regulation cost of accidents, Role of safety personnel, Accident causes and principles of safety, Safety and health management system.	**2**	**5**
12	**Linear programming in construction management**: Formulation of model, Graphical and Simplex method.	**2**	**5**
13	**Factors for success of a construction project:** Project performance measurement and project evaluation criteria, Project performance attributes, Effect of other elements on project performance	**4**	**10**

Reference Books:

1) Construction project management: Theory and Practices, 2nd edition, 2016, Kumar Niraj Jha, Pearson Education Publishers.
2) Project management for engineering and Construction, By Garold D Oberlender, 2nd Edition, McGraw Hill Education (India), Pvt. Ltd.
3) CPM and PERT: Punamia & Khandelwal.
4) Construction planning and management, P S Gehlot and B M Dhir, Wiley Eastern Ltd.
5) A management guide to PERT/ CPM by Weist and Levy, Prentice Hall
6) Construction management, P P Dharwadkar.
7) Construction of Structures and Management of Works, S. C. Rangwala, Charotar Publications.

COURSE OUTCOMES:

After completing the course, the students will be able to:

2180611.1 **Understand** the basic concepts of construction project and management of Civil Engineering construction industry.

2180611.2 **Prepare** the various network diagram and construction planning techniques used in Civil Engineering projects.

2180611.3 **Appraise** the projects with reference to economic and financial aspects.

2180611.4 **Apply** the basic principle of accounts, equipment, material and safety management to various Civil Engineering projects.

2180611.5 **Analyse** the construction project cost and value management and total quality management as per quality ISO standards.

2180611.6 **Evaluate** accident causes, unsafe conditions and project performance attributes for success of a construction project and various soft programming techniques to solve Civil Engineering projects problems.

CO-PO-PSO MAPPING:

	PROGRAM OUTCOMES												PSOs				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**
2180611.1	2	-	-	-	-	-	-	-	-	-	-	2	3	2	-	-	3
2180611.2	3	2	2	-	3	-	-	-	-	-	-	2	3	-	-	2	2
2180611.3	2	-	-	2	-	-	-	2	2	-	3	3	2	1	-	-	2
2180611.4	3	-	-	2	3	2	-	2	-	-	3	2	2	-	2	-	2
2180611.5	2	-	-	-	-	2	2	2	-	-	2	2	2	-	2	-	2
2180611.6	3	2	2	2	-	-	-	2	2	2	-	2	3	-	-	-	2
2180611	**2.5**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2.67**	**2.17**	**2.5**	**1.5**	**2**	**2**	**2.17**

3: Strong 2: Moderate 1: Low - : NA

CO-PO MAPPING & JUSTIFICATION:

Mapping	Level	Justification
2180611.1-PO1	2	Understand the basic knowledge about civil engineering projects, its organization and various management techniques.
2180611.1-PO12	2	Civil Engineering Project and management skill will help to develop the ability to engage in independent leadership of project.
2180611.2-PO1	3	Apply the basic concepts of various management techniques to be used for civil engineering projects to solve the problems.
2180611.2-PO2	2	With the help of management and control tools, identify and formulate the problem to analyze the complex problems.
2180611.2-PO3	2	After analyze the problem, feasible alternate general solutions can be developed to provide the environmental friendly solutions.
2180611.2-PO5	3	Engineer can select and apply the modern software and techniques for prediction and modelling.
2180611.2-PO12	2	The network techniques will be helpful to develop the career and solely leads a project after gaining experience in the field.
2180611.3-PO1	2	Apply the knowledge of economic and finance management to civil engineering projects.
2180611.3-PO4	2	Conduct the investigation and carry out the feasibility analysis of project proposal, detailed project report considering economically and financially viable projects.
2180611.3-PO8	2	Application of ethical principles and commitment to professional ethics and responsibilities are of prime significance while dealing with aspects of finance and economic.
2180611.3-PO9	2	For civil engineering projects, to work with teamwork of subordinates and stakeholders are formal to justify the need of the projects at various stages.
2180611.3-PO11	3	For economic and financial aspect, demonstration and understanding of the engineering and management principles and these apply to own work as a member and a team leader to manage the project

2180611.3-PO12	3	Project management is very important to recognize the need of resources at different levels and also to develop the ability to do the task independently.
2180611.4-PO1	3	Apply the basic knowledge of account, equipment, material and safety management to solve the engineering problems to be occurred during the execution of work at the site.
2180611.4-PO4	2	Based on research done, conduct investigations in regards with any changes in selection of equipments and materials for the success of completion of projects.
2180611.4-PO5	3	Select the appropriate materials and equipments to execute the work and safety devices or measures to avoid any hazards during the construction of work.
2180611.4-PO6	2	Assess the impact of materials and equipments to societal, health and safety, legal and cultural issues and challenges.
2180611.4-PO8	2	While execution and management of activities, apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
2180611.4-PO11	3	Demonstrate the knowledge and understanding of engineering and management principles and apply to own work as a member or team leader to manage projects for account, material and equipment managements.
2180611.4-PO12	2	In context with technological change to adopt the advanced equipments and materials use to the ongoing or forthcoming project to execute the work and make it in practice for lifelong learning.
2180611.5-PO1	2	Basic knowledge of engineering fundamentals to analyse the project cost and value using cost codes and cost statement is essential part of construction project management.
2180611.5-PO6	2	The total quality management and quality assurance as per ISO standards is necessary to apply by the knowledge to assess societal, health and legal issues.
2180611.5-PO7	2	To understand the impact on environment and sustainability is the key points in concern with the quality control and management.
2180611.5-PO8	2	Apply engineer's ethics to achieve the quality of work and to commit them with responsibilities is the traits of a civil engineer.
2180611.5-PO11	2	Analysis of construction project and value with it demonstrating knowledge and understanding is an essential parameter for project management and finance to apply to the work as member or leader.
2180611.5-PO12	2	Recognize the need for cost analysis is important aspect for developing ability to engage independent and lifelong learning.
2180611.6-PO1	3	Apply the knowledge of engineering specialization to solve the complex problems of occurring accidents on site and apply safe working conditions and environment.
2180611.6-PO2	2	Identify and formulate the problems by conducting research on the critical issues and challenges with regard of increasing safety.
2180611.6-PO3	2	Develop the feasible possible solutions to minimize the accidents and enhance public health and safety.
2180611.6-PO4	2	Conduct the investigations based on research based knowledge to interpret data and to provide information with valid conclusions is necessary for the success of a civil engineering project.

2180611.6-PO8	2	Apply ethical principles of a civil engineer with commitment of responsibility is essential for success of a construction project.
2180611.6-PO9	2	For successful completion of a project, engineer has to perform their task effectively as an individual and also in a team in multidisciplinary directions.
2180611.6-PO10	2	In the layout of project organization, the effective and correct representation and communication at all the levels of management is required in order to resolve the solutions effectively and timely.
2180611.6-PO12	2	Project performance attributes for success of a construction projects are key parameter which can be recognized carefully to develop the ability to work and lead as an independent for lifelong learning process in context of technological change.

CO-PSO MAPPING & JUSTIFICATION:

Mapping	Level	Justification
2180611.1-PSO1	3	By knowing the basic concepts of project organization and its management graduates will be able solve the problems at the site.
2180611.1-PSO2	2	They can achieve expertise in analysis and design of suitable structure or forms of project organization in civil engineering projects and manage the various functions of each.
2180611.1-PSO5	3	By understanding the basic concepts of project organization and management, graduates will be able to pursue their career as professional entrepreneur.
2180611.2-PSO1	3	Apply technical knowledge and skill for solving the civil engineering problems related to construction planning using suitable network techniques and software.
2180611.2-PSO4	2	Graduates will design functionally efficient network diagram to execute, manage and control the various activities involving in the projects.
2180611.2-PSO5	2	They can expertise in preparing network diagram and scheduling for vast projects using appropriate tools and develop career as an entrepreneur.
2180611.3-PSO1	2	Apply technical knowledge and skill for economic and financial aspect of projects to evaluate the appraisal.
2180611.3-PSO2	1	They can achieve expertise in evaluation of projects for its feasibility and viability point of view to justify the requirements of the projects.
2180611.3-PSO5	2	Become professional in the field of assessing the detail project report considering its economic and financial justification required for the final approval of the project to execute.
2180611.4-PSO1	2	Actively apply the technical knowledge and skill to civil engineering project related to account, equipments and materials.
2180611.4-PSO3	2	By adopting suitable choice of materials and equipments, safety can be achieved following user's guide and precautionary measures which make environmental friendly sustainable conditions for work execution.
2180611.4-PSO5	2	They can starts as an entrepreneur career in the field of equipment, accounts and also become a safety engineer or advisor for handling the vast civil engineering projects.

2180611.5-PSO1	2	Apply knowledge and skill to analyse the construction project cost and its value using various cost codes and cost statements.
2180611.5-PSO3	2	By better control on quality under total quality management and quality assurance as per quality ISO standards, become responsible technocrats for environmental friendly sustainable solutions for quality related problems, issues and challenges.
2180611.5-PSO5	2	They can develop career as a quality control engineer or consultant to look after such issues and manage the project quality wise with professional responsible and ethics.
2180611.6-PSO1	3	Civil Engineer can apply technical knowledge to evaluate the accident causes to solve real life problems and create safe working conditions which leads a step forward for the successful completion of the project.
2180611.6-PSO5	2	Become a project manager to be development of the career by the achieved success of the projects handled as an individual or working in a team as a member or team leader.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING

DESIGN OF PRESTRESSED CONCRETE STRUCTURES & BRIDGES

SUBJECT CODE: 2180612

B.E. SEMESTER-VIII

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	00	20	150

Syllabus:

1	Prestressed Concrete Introduction, Basic Concepts, History of development of materials and prestressing, different methods of prestressing, Advantages and Limitations, IS provisions related to materials properties & prestressing.
2	Prestressed Concrete Analysis of member for prestress and bending stresses at various stages; Pressure Line; Stress, strength and Load Balancing concepts; Losses in presstress; short term and long term deflections; flexural ,shear and torsional strength, Estimation of crack width. Fatigue and impact strength, resistance to fire and corrosion.
3	Prestressed Concrete Transfer of prestress in pretensioned and posttensioned members, stress distribution at end anchorages, anchorages and end block design; Limit state design criteria, design of pre and post tensioned girders; design of post tensioned one way and two way slabs
4	Bridges Classification of bridges, investigations and planning, choice and type of bridges, General design specifications, Loads acting on bridges, Live load specifications for road bridges as per IRC, Load distribution theories - Courbon's Method, Grillage analogy, Pigeaud's curves.
5	Bridges (Design of Superstructure) General design considerations, analysis and design of simply supported RC slab type, T beam type bridges, Forces acting on bearing, Design of bearing, General aspects of pre-tensioned and Post tensioned prestressed bridge decks- Principles of design only.
6	Bridges (Design of Substructure) Types of substructures, Loads acting on substructure, Transfer of loads from superstructure to substructure, Analysis and design of substructure elements, shallow foundation, deep foundations (only design principles), Design of other components like wing wall, return wall

Reference Books:

(A) Prestressed Concrete

1. Krishna Raju N. Pre stressed Concrete, Tata McGraw Hill Co.

2. Rajagopal N., Prestressed Concrete, Narosa Publishing House.

3. Dayarathnam P., Prestressed Concrete Structures, S.Chand Publishers.

4. Sinha N.C. and Roy S.K., Fundamentals of Pre-stressed Concrete, S.Chand &Company limited.

5. T. Y. Lin, Design of Prestressed Concrete Structures, Wiley India Pvt. Ltd.

6. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co. Pvt. Ltd.1997.

7. A. Nilson, Design of Prestressed Concrete, John Willey & Sons.2nd edition, 1987.

8. Leonhardt F., Wilhelm Ernst and Shon, Prestressed Concrete- Design and Construction –, Berlin

9. Evans, R.H. and Bennett, E.W., Prestressed Concrete Theory and Design, Chapman and Hall, London.

10. Prestressed Concrete by The Freyssinet Prestressed Concrete Co. Ltd.,

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6. Bakht, B. and Jaegar, L.G., "Bridge Analysis simplified", McGraw Hill, 1985.

7. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 1989

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After learning the course the students should be able to:

1. **Apply** concepts & methods for pre stressing systems for different materials.
2**. Compute** stresses in beams due to transverse loads & prestressing.
3. **Determine** the losses in beams due to prestress, short and long term deflection, flexural and shear strength of beam.
4. **Design** the pre-tensioned and post-tensioned concrete beams & slab, anchorage zones.
5. **Explain** various specifications of IRC for planning, analysis & design of bridges.
6. **Design** of simply supported RC slab & girder type superstructure as per IRC specifications, substructure, foundation and adjoining elements.

	PROGRAM OUTCOMES												PSOs				
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
2180612.1	3	1	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-
2180612.2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-
2180612.3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-
2180612.4	2	1	3	-	-	-	-	1	1	-	-	1	2	3	-	1	-
2180612.5	3	2	2	-	-	-	-	-	-	-	-	1	1	2	1	2	-
2180612.6	2	3	3	-	-	-	-	-	-	-	-	1	1	2	-	1	-
2180612	2.66	1.83	2.66	-	-	-	-	1	1-	-	-	1	1.66	2.33	1	1.33	-

3: Strong 2: Moderate 1: Low -:NA

Mapping	Level	Justification
2180612.1-PO1	3	Basic knowledge of concept and method of pressressing will be gained by students.
2180612.1-PO2	1	Concepts and method of presstressing system will be identify and formulis will be derive based on theoretical aspect.
2180612.2-PO1	3	This course will deliver knowledge of computing stresses in beams due to presstressing.
2180612.2-PO2	2	Computation of stresses in beam related to presstressing will be derived by using principle of structural analysis.
2180612.3-PO1	3	Students will be able to determine the losses in beam, short and long term deflection and strength parameter for beam using presstressing method.
2180612.3-PO2	2	Students will use the concept of presstressing for analyse the beam for determine parameter required.
2180612.4-PO1	2	Students will be able to design the problem related to pre and post tensioned concrete beams and slabs.
2180612.4-PO2	1	Stundets will be capable of analyse the complex engineering problem related to presstressing for concrete beams and slabs.
2180612.4-PO3	3	Design solution for pre and post tensioned concrete beams and slabs will be done for specific need including anchorage zone.
2180612.4-PO8	1	Professional ethics and ethical principles will be understand in the design solution of presstress concrete structures.
2180612.4-PO9	1	Individual capacity as a structural designer will be achieved by the students in the area of presstress concrete structure.
2180612.4-PO12	1	Students will be able to engage as a structural designer for the design of presstressing structure in conatext of technological change.

2180612.5-PO1	3	Students should understand concepts of various specification of IRC for planning, analysis and design of bridges.
2180612.5-PO2	2	Stundets will be able to analyse the bridges as per specification of IRC.
2180612.5-PO3	2	Design of bridges will be done for complex engineering problem related to various components of bridges as per IRC guideline.
2180612.5-PO12	1	Based on the current recommendation as per IRC for analysis and design of bridge will be useful for advanced computing software techniques.
2180612.6-PO1	2	Students will be gain the knowledge of analysis and design of RC slab and girder for super structure as well as for sub structure and adjoining elements.
2180612.6-PO2	3	Students will be able to analyes the complex problem of RC slab and girder as well as foundation and adjoining elements.
2180612.6-PO3	3	Student will be capable of designing the super structure and sub structure components of bridges and presstressing member.
2180612.6-PO12	1	Knowledge of anlaysis and design of presstressing bridges and other structural elements will be co-relate with advanced techniques.