GUJARAT TECHNOLOGICAL UNIVERSITY

ADVANCE ENGINEERING MATHS
SUBJECT CODE: 2130002
B.E. 3RD SEMESTER

Type of course: Engineering Mathematics

Prerequisite: The course follows from Calculus, Linear algebra

Rationale: Mathematics is a language of Science and Engineering

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	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 Outcome:

After learning the course the students should be able to

1. Fourier Series and Fourier Integral
   - Identify functions that are periodic. Determine their periods.
   - Find the Fourier series for a function defined on a closed interval.
   - Find the Fourier series for a periodic function.
   - Recall and apply the convergence theorem for Fourier series.
   - Determine whether a given function is even, odd or neither.
   - Sketch the even and odd extensions of a function defined on the interval [0,L].
   - Find the Fourier sine and cosine series for the function defined on [0,L]
2. Ordinary Differential Equations and Their Applications
   - Model physical processes using differential equations.
   - Solve basic initial value problems, obtain explicit solutions if possible.
   - Characterize the solutions of a differential equation with respect to initial values.
   - Use the solution of an initial value problem to answer questions about a physical system.
   - Determine the order of an ordinary differential equation. Classify an ordinary differential equation as linear or nonlinear.
   - Verify solutions to ordinary differential equations.
   - Identify and solve first order linear equations.
   - Analyze the behavior of solutions.
   - Analyze the models to answer questions about the physical system modeled.
   - Recall and apply the existence and uniqueness theorem for first order linear differential equations.
   - Identify whether or not a differential equation is exact.
   - Use integrating factors to convert a differential equation to an exact equation and then solve.
   - Solve second order linear differential equations with constant coefficients that have a characteristic equation with real and distinct roots.
   - Describe the behavior of solutions.
   - Recall and verify the principal of superposition for solutions of second order linear differential equations.
   - Evaluate the Wronskian of two functions.

- Determine whether or not a pair of solutions of a second order linear differential equations constitute a fundamental set of solutions.
- Recall and apply Abel's theorem.
- Apply the method of reduction of order to find a second solution to a given differential equation.
- Apply the method of undetermined coefficients to solve non-homogeneous second order linear differential equations.
- Model undammed mechanical vibrations with second order linear differential equations, and then solve. Analyze the solution. In particular, evaluate the frequency, period, amplitude, phase shift, and the position at a given time.
- Define critically damped and over damped. Identify when these conditions exist in a system.
- Describe the phenomena of beats and resonance. Determine the frequency at which resonance occurs.
- Recall the definition of linear independence for a finite set of functions. Determine whether a set of functions is linearly independent or linearly dependent.
- Use the method of variation of parameters to solve non-homogeneous higher order linear differential equations.

3. Series Solution of Differential Equations

- Manipulate expressions involving summation notation. Change the index of summation.
- Find the general solution of a differential equation using power series.
- Given an initial value problem, use the differential equation to inductively determine the terms in the power series of the solution, expanded about the initial value.

4. Laplace Transforms and Applications

- Sketch a piecewise defined function. Determine if it is continuous, piecewise continuous or neither.
- Evaluate Laplace transforms from the definition.
- Determine whether an infinite integral converges or diverges.
- Evaluate inverse Laplace transforms.
- Use Laplace transforms to solve initial value problems.
- Convert piecewise defined functions to functions defined in terms of step functions and vice versa.
- Find the Laplace transform of a piecewise defined function.
- Apply the shifting theorems to evaluate Laplace transforms and inverse Laplace transforms.
- Use Laplace transforms to solve differential equations with discontinuous forcing functions.
- Define an idealized unit impulse function.
- Use Laplace transforms to solve differential equations that involve impulse functions.
- Evaluate the Laplace transform of a convolution of functions.
- Use the convolution theorem to evaluate inverse Laplace transforms.

5. Partial Differential Equations and Applications

- Determine the order of a partial differential equation.
- Classify a partial differential equation as linear or nonlinear.
- Verify solutions to partial differential equations.
- Apply the method of separation of variables to solve partial differential equations, if possible.
- Find the solutions of heat conduction problems in a rod using separation of variables.
- Solve steady state heat conduction problems in a rod with various boundary conditions.
- Solve the wave equation that models the vibration of a string with fixed ends.
- Describe the motion of a vibrating string.

- Solve Laplace's equation over a rectangular region for various boundary conditions.
- Solve Laplace's equation over a circular region for various boundary conditions.

List of Open Source Software/learning website:

1. NPTEL
   http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/Course_home4.30
   https://www.youtube.com/watch?v=DPg5T-YBQjU
   https://www.youtube.com/watch?v=7fJeo1fylKI
   https://www.youtube.com/watch?v=1FnBPmEWpus
   https://www.youtube.com/watch?v=dgDIQ0VA0pA
   https://www.youtube.com/watch?v=SoBs-YGQUdc
   https://www.youtube.com/watch?v=Fh8m6ZdFaqU

2. **Instructor(s):** Prof. Haynes Miller, Prof. Arthur Mattuck

   http://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/

3. **Instructor:** Prof. Haynes Miller, Prof. Arthur Mattuck, Dr. John Lewis

   http://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICS OF SOLIDS
SUBJECT CODE: 2130003
B.E. 3RD SEMESTER

Type of course: Applied Physics

Prerequisite: System of units
Laws of motion
Basic idea of force
Concept of centroid
Fundamentals of stress, strain and their relationships

Rationale: Mechanics of Solids is conceptual applications of principles of mechanics in Engineering

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		
4	0	2	6	70	20	10	20	10	20	150

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	Module 1		
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.	02	20
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 statically determinate pin – jointed structures. **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, Equilibrium conditions of coplanar non-concurrent force system, Application of these principles.	08	
	Module 2		
3	**Applications of fundamentals of statics**	08	15

	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.		
Module 3			
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.	06	20
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,	08	
Module 4			
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.	10	20
Module 5			
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.	06	25
8	**Torsion:** Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity.	04	

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	04	
Module –VI			
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	05	50% (Practical) & 0% (Theory)
11	**Simple Machines: (laboratory hours)** Basics of Machines, Definitions: Velocity ratio, mechanical advantage, efficiency, reversibility of machines. Law of Machines, Application of law of machine to simple machines such as levers, pulley and pulley blocks, wheel and differential axle, Single purchase, double purchase crab, screw jacks. Relevant problems.	05	

Course Outcome:

After learning the course the students should be able to:

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

List of Experiments:

The students will have to solve atleast five examples and related theory from each topic as an assignment/tutorial. Students will have to perform following experiments in laboratory and prepare the laboratory manual.

Mechanics of rigid body

1. Equilibrium of coplanar concurrent forces
2. Equilibrium of coplanar non-concurrent forces
3. Equilibrium of coplanar parallel forces: Determination of reactions of simply supported beam
4. Verification of principle of moment: Bell crank lever
5. Determination of member force in a triangular truss
6. Determination of coefficient of static friction using inclined plane
7. Determination of parameters of machines (Any two)

(a) Wheel and differential axles
(b) Single purchase crab
(c) Double purchase crab
(d) System of pulleys

Mechanics of deformable body

8. Determination of hardness of metals: Brinell /Vicker/Rockwell hardness test
9. Determination of impact of metals: Izod/Charpy impact test
10. Determination of compression test on
    (a) Metals – mild steel and cast iron
    (b) Timber – along and parallel to the grains
11. Determination of tensile strength of metals
12. Determination of shear strength of metals

Design based Problems (DP): (any two)

1. For a real industrial building having roof truss arrangement, (a) take photograph & identify type of truss, (b) draw sketch of truss with all geometrical dimension, cross sections details, type of joints, type of support conditions (c) prepare a model of truss (d) identify & determine types of load acts on it (d) determine support reactions & member forces due to dead load & live load only.
2. Take a case of the Mery-Go-Round used in the fun park. Draw its sketch showing radius of wheel, no of seats, capacity of each seats and other related information. Determine the amount of resultant produced at the centre of wheel during rest position, when (i) it is fully loaded (2) it is 30% loaded with symmetric arrangement. Draw support arrangement and determine support reactions. Also determine amount of torque required to start its operation.
3. Prepare working models for various types of beams with different shape of cross section, supporting conditions and study the effect of cross section on the deflection of beams.
4. Prepare working model of simple lifting machine using different types of pulley systems and calculate various parameters like load factor, velocity ratio, law of machine, efficiency of machine etc.

Major Equipments:

1. Force table
2. Beam set up
3. Truss set up
4. Bell crank lever
5. Friction set up
6. Lifting machine
7. Hardness testing machine
8. Impact testing machine
9. Universal testing machine with shear attachment

List of Open Source Software/learning website:
www.nptel.iitm.ac.in/courses/

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will

allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

DESIGN ENGINEERING
SUBJECT CODE: 2130005

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

Design Engineering 1, 2 and 3

What is design? Design is a plan of a system, its implementation and utilization for attaining a goal. It is to change undesired situation into desired situation means to find solution for undesired/uncomfortable situation.
Designs can be for
(1) Technical systems (power plant)
(2) Educational systems (Montessori Method)
(3) Aesthetic systems (logo designs, advertisements)
(4) Legal systems
(5) Social, religious or cultural systems
(6) Theories, Models, etc.

Design thinking gives students a taste of the rich internal-remunerations associated with knowledge-creation and in curiosity and problem-driven contexts. Design need to satisfy technical functions, ergonomics functions, aesthetic functions, cost function and environment functions.

Essential features of Design:
Design solution of a problem starts with planned constructions for achieving goal/s. Designing means evolving goal oriented processes. At the beginning of the design process only goals are known while at the end, both the goals and plans are known and that to with more clarity. Goal and plans evolve together and they influencing each other. In designing process some goals are more important than others and similarly some plans are better than others. Designing does not guarantee that the design will work.

Design thinking process:
(1) Find goals or need
(2) Evaluate goals or need
(3) Generate proposals to satisfy goals
(4) Evaluate proposals
(5) Improve goals and proposals

Teaching methodology:
The design engineering should be with fun and should create excitement. It should be integrated theme across the various courses. It should promote the team work. Design is thinking and doing. The complete design process should be included in design engineering 1, 2 and 3. The prototype design must consider technical, aesthetic, ergonomics, cost and environmental requirements.

Content:

Design Engineering 1: (3 credits in Semester 3, 3 credits in Semester 4)
Introduction to product innovation process (Need-requirement-concept-detail-prototype-services-business)
Modules on: Task clarification and conceptualization: Problem-idea-solution-evaluation

- Problem identification
- Ideation
- Consolidation
- Evaluation

Project: identifying need to developing proof of concept to demonstrate solution selected

Students can tackle simple design problems with engineering content – posed by the teacher or based on a survey of real life concerns of the public. The second is more effective – the students "own the problem" - but has to be accepted by the teacher.

Examples: (a) A device to help carry heavy luggage to the upper floors of a building – a building that has no lifts. (b) Systems to ensure that water does not come out as a jet from the taps in the lower floors of a tall building. One can insist on multiple realistic solutions and all should be part of the submission along with statements of their shortcomings or advantages. Teacher should not entertain fancy solutions – based on fancy ideas - with no engineering or scientific basis.

Short lectures on the topics in the syllabus should parallel the activity.

Design Engineering 2: (3 credits in Semester 5, 3 credits in Semester 6)
Introduction to detail design
Modules on

- Design for performance, safety, reliability
- Design for ergonomics and aesthetics
- Design for manufacturability
- Design for cost, environment

Project: developing the concept into a detailed design with a functional prototype

Here one could ask students to develop products based on themes - "Garbage compactors, Energy from kitchen waste, etc" making sure that the problems identified by the students within the themes possess an engineering content and insisting on some facets of design for assembly, for manufacturability, ...and so on while preparing the design and the prototypes. One could encourage students to innovate, arrive at multiple solutions and conduct a detailed design of one of the solutions.

Prototyping requires funds and effort, so it pays to identify one subsystem of the design of the whole machine. One can insist on prototyping demonstrating at least that sub-system, if not the whole system.

Design Engineering 3: (3 credits in Semester 7, 3 credits in Semester 8)
Introduction to services and business planning
Modules on

- Design of services
- Intellectual property
- Materials and recourse planning
- Business planning

Project: developing a business model

OR

Research or Technology Development project
Modules on

- Detailed literature survey and to find out technology gap
- Intellectual property
- Re-evaluate prototype of DE-2 and proposal of novel idea

Project: developing a novel functional prototype

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06) / MINING (22)

SURVEYING

SUBJECT CODE: 2130601

B.E. 3rd Semester

Type of course: Engineering and Technology

Prerequisite: Student shall have studied basic Elements of Civil Engineering

Rationale: To develop concepts of various types of land surveying and prepare and interpret maps and drawing.

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.	Topics	Teaching Hrs.	Module Weightage
Module 1			
1	Plane Table Survey: Introduction, principle, instruments, setting up the plane table, methods of plane tabling, advantages, sources of Errors.	10	20
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	10	20
3	Trigonometric levelling: Indirect levelling, levelling on steep ground- methods.	6	15
Module 2			
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.	6	15
Module 3			
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	15
Module 4			

6	Hydrography: Introduction, purposes, control points, soundings, instruments & methods of locating soundings.	2	5
7	Setting out Works: Building, Culvert, Bridge, Tunnel	2	5

Reference Books:

1. Surveying Vol.I, II and III by Dr. B.C. Punamia
2. Surveying and Levelling Vol. I and II by T.P Kanetkar and S.V Kulkarni
3. Surveying Vol. I, II and III by Dr. K.R. Arora
4. Surveying Vol. I and II by S. K. Duggal
5. Surveying and Levelling by N.N. Basak
6. Surveying and Levelling by R. Agor
7. Advanced Surveying by R. Agor.
8. Roy, S.K., Fundamentals of Surveying, Prentice Hall India, New Delhi
9. Subramanian, R., Surveying and Leveling, Oxford University Press, New Delhi

Course Outcome:

- Conduct plane table and theodolite traverse surveys at identified Site.
- Conduct trigonometrically leveling
- Set out simple circular and transition curves at given location
- Compute areas and volumes using standard rules and equipment's such as planninmeter
- Conduct hydrographical survey
- Give layout of foundations for buildings, culverts, bridges and tunnels as per plan/drawing.

List of Experiments:

- Plane table traversing by intersection and radiation methods
- Two point problem and three point problem
- Theodolite traversing and plotting of traverse by applying corrections in Gale's traverse table
- Setting out simple circular curve by different methods
- Setting out combined curve (Transition - Circular – Transition)
- Setting out building foundations
- Computation of area of submergence and storage volume from contour maps for reservoir projects.

Design based Problems/Open Ended Problems:

1. To find the capacity of reservoir
2. Identify location of recharge well for various sites

Term Work:

Term work shall be based on the following field projects conducted by students:
1) Plane table survey project.
2) Theodolite traverse survey project.
3) Setting out of curve.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)

FUILD MECHANICS

SUBJECT CODE: 2130602

B.E. 3rd Semester

Type of course: APPLIED PHYSICS

Prerequisite: System of units, Laws of motion, Basic idea of force, Concept of centroid

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 dynamicsand understand and apply the Bernoulli principle.
5. Calibrate fluid flow measuring devices like venturimeter, orificemeter, notches, orifice, mouthpieces.
6. Understand the concept of drag and lift on various objects.
7. Know the basics of compressible fluid flow.

List of Practicals:

Students will have to perform following experiments in laboratory and prepare the laboratory manual. The students will have to solve atleast five examples and related theory from each topic as an assignment/tutorial.

- Measurement of viscosity (Verification of Stokes law)
- Study of pressure measurement devices
- Hydrostatic force and center of pressure on flat/curved surfaces
- Stability of Floating body
- Study Characteristics of Laminar and Turbulent flows (Reynolds experiment)
- Verification of Bernoulli Theorem
- Determine Hydraulic coefficients of a small circular orifice.
- Calibration of flow measuring devices (Venturimeter, Orificemeter)
- Calibration of Rectangular and V notch.
- Drag on immersed objects.

Design based/open ended problem

1. Measurement of capacity of storage tanks
2. Measurement of viscosity of different fluids
3. Measurement of pressure and discharge in pipe flow
4. Comparison of time of emptying a tank computed theoretically and actually observed (Using mouth pieces, orifices).
5. For the college building/ department determine the pressure head,peizometric head from a water tank at a point of interest in flow system.
6. Measurement of pressure in aninflated tube.
7. Prepare working model for falling sphere viscometer, stability of floating bodies
8. Prepare working models of different types of gates for storing water/liquid in a tank/reservoir.
9. Prepare working models of different types of notches, weirs, and orifice.
10. Estimate the time to empty the water /liquid tank of different shapes with orifice.
11. Estimate drag force on objects (like advertisement display board,) or design of a parachute etc.
12. Any other related problem framed by college faculty.

Major Equipments:

1. Viscometer

2. Piezometers, Manometers, pressure gauges
3. Centre of pressure
4. Floating body
5. Reynolds experimental setup
6. Hydraulic bench with modular attachments for various experiments
7. Open channel with flow and depth measurement setup etc.

List of Open Source Software/learning website:
www.nptel.iitm.ac.in/courses/

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)

GEOTECHNICS & APPLIED GEOLOGY

SUBJECT CODE: 2130606

B.E. 3rd Semester

Type of course: Applied Mechanics

Prerequisite: Geological cycle
Basic rock types
Properties of material
Fundamental knowledge of engineering mathematics.
Knowledge of principles of mechanics

Rationale: Geotechnics is required to equip the students to understand the properties and behavior of soil for the design of structures. To introduce students with basic principles of geosciences and their applications in civil engineering.

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

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	Module 1		
1	**Introduction:** Definition, brief history, scope, and limitations of Geotechnics.	01	30
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.	02	
3	**Index Properties, Relationships and Tests:** Phase diagram, Basic terms and definitions, Functional relationships,Determination of index properties, Relative density for granular soil.	05	
4	**Particle Size Analysis:** Size and nomenclature of soil particles as per IS, Sieve analysis, Sedimentation analysis, Particle size distribution curve and its uses.	03	
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.	02	

6	**Soil Consistency:** Consistency limits and its determination, different indices, Field moisture equivalent, Activity, Sensitivity & Thixotropy of soil.	03	
7	**Soil Classification:** Objectives, Basis, Textural, Unified soil classification, IS classification method, group index. Field identification and General characteristics of the soil.	03	
Module 2			
8	**Soil Water:** Free water and held water, Structural water and absorbed water, Capillary	02	20
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.	07	
Module 3			
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.	06	25
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.	06	
Module 4			
12	**Geological time-scale and laws of stratigraphy:** Introduction to geological time scale and stratigraphy, Laws of stratigraphy.	01	25
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	07	

	geological cross section.		
14	**Hydrogeology:** Hydrological cycle and groundwater occurrence.	01	
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.	07	

Reference Books:

1. Arora K. R., Soil Mechanics & Foundation Engineering, Standard Publications.
2. Punmia B. C., Soil Mechanics & Foundations, Laxmi Publications,
3. Murthy V. N. S., Soil Mechanics & Foundation Engineering, Dhanpat Rai, Engineering
4. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
5. Gopal Ranjan & Rao A. S. R., Basic & Applied Soil Mechanics, New Age International Publishers
6. Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
7. G. H. Davis, Stephen J. Reynolds and Charles F. Kluth, Structural Geology of Rocks and Regions 3rd Edition, Wiley 2012.
8. S. K. Ghosh, Structural Geology: Fundamentals and Modern Developments, Elsevier Ltd, 2013.
9. F. G. Bell, Engineering Geology Second Edition, Elsevier Ltd, 2007..
10. Parbin Singh, Engineering and General Geology, S. K. Kataria & Sons 2010.

Course Outcome:

After learning the course the students shall be able to:

1. Know soil formation, types of soils, types of soils found in various parts of India.
2. Determine the index properties and interrelationships between various soil parameters.
3. Understand the different types of soil classification systems. Classify field soils as per particle size and atterberg's indices.
4. Know types of soil water found in nature, it's permeability characteristics and seepage determination.
5. Students will understand forces acting upon the surface of the Earth. Students will be able to appreciate processes and geological agents involved in the shaping surface of the earth, and will learn about the landforms produced as a result of these processes.
6. Students will be made familiar with the internal structure of the Earth, its properties and processes.
7. Students will learn theory of continental drift and sea-floor spreading. Students will also be able to understand mechanism and processes involved with plate tectonics, types of plate boundaries, processes happening at the plate-boundaries and geological features produced at the plate-boundaries.
8. Students will be able to know about hazards due to volcanic and seismic activity.
9. Students will be able to identify major mineral and rock types in hand-specimen.
10. Students will become familiar with the different types of geological structure and understand hazard associated with their presence at site.
11. Students will be able to predict the likely engineering behaviour of rocks under specified geologic conditions.
12. Students will be able to interpret engineering geologic maps.
13. Students will learn about use of satellite data and GIS for engineering geology.

List of Experiments:
Geotechnics lab:

1. Visual identification and specific gravity
2. Sieve Analysis
3. Hydrometer Analysis
4. Liquid and Plastic Limit Test
5. Shrinkage limit Test
6. In-situ Density-Core Cutter & Sand Replacement method
7. Permeability Test: Constant and Variable Head

Geology Lab:

1. Study of physical properties of major rock forming minerals.
2. Study of rock specimen.
3. Study of Strike and dip using models.
4. Numerical problems related to dip, strike and outcrop.
5. Preparation of geological cross section.
6. Case study: Geologic problems encountered during civil engineering projects.
7. Interpretation of satellite data and use of GIS software.

Field Application:

To collect various soil samples from local area and classify the soil as per IS.
Geologic field tour to study different types of geological structures and rocks.

Design Oriented Problems:

1. Prepare a chart showing soils available at different regions of Gujarat State with tentative soil properties, Which actually results in prediction of soil behavior approximately.
2. Prepare a working model to make student understand concept of permeability for different types of soil.
3. Prepare a working model which demonstrates horizontal and vertical permeability for stratified mass.

Term Work:

Term work shall consist of laboratory work (Minimum 05 Experiments from listed below) and tutorials (minimum 15 problems) based on above course. Practical examinations shall consist of oral based on term work and above course.

List of Open Source Software/learning website:www.nptel.iitm.ac.in/courses/

*PA (M): 10 marks for Active Learning Assignments, 20 marks for other methods of PA

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GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)

BUILDING CONSTRUCTION

SUBJECT CODE: 2130607

B.E. 3rd Semester

Type of course:

Prerequisite: Student shall have studied basic Elements of Civil Engineering

Rationale: To develop capability to understand building components

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	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

Sr. No.	Topics	Teaching Hrs.	Module Weightage
Module 1			
1	Introduction: Overview of construction practices, theory and methods.	10	20
2	Subsurface Investigation: Objectives, methods of boring like wash boring, percussion etc.,		
3	Shallow Foundations: Necessity, types, setting out, excavation, construction, failures of foundation and remedial measures.		
Module 2			
4	Masonary Construction : 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	08	20

	e) Cavity walls: Brick cavity walls, position of cavity at foundation, roof and at opening levels. f) Lintels & arches: Lintels – types, construction. Arches – technical terms, types – brick arches, rough, axed, stone arches, flat – semi circular.		
5	Plain and Reinforced Concrete Construction: Pre-cast and cast-in-situ Construction		
Module 3			
6	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.	08	20
7	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.		
Module 4			
8	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.	08	20
7	Roofs and Roof Coverings: Introduction, requirements of good roof technical terms, classification, types of roof coverings for pitched roof. 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.		
8	Wall Finishes: Plastering, pointing and painting		
9	Temporary Works : Timbering in trenches , types of scaffoldings, shoring, underpinning		
Module 5			
10	Special Treatments: Fire resistant, water resistant, thermal insulation, acoustical construction and anti-termite treatment.	04	10
Module 6			
11	Green Building: Principles, Concepts and Case study	04	10

Reference Books:

1. Building Construction by Dr. B. C. Punamia
2. Building Construction by Sushil Kumar
3. Building Construction by Gurcharan Singh
4. Building Construction by S. C. Rangwala
5. Building Construction by P.C Varghese,Prentice-Hall of India, New Delhi
6. Indian Standard Institution, National Building Code of India, ISI, 1984, New Delhi

Course Outcome:

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

- Discuss sub surface soil strata investigation.
- Construct various types of shallow foundation.
- Execute various types of masonry.
- Construct various structural and non-structural building components.
- Erect various temporary works for new and existing buildings.
- Apply special treatments like water resistance, thermal insulation acoustical construction.
- Select appropriate method of construction.
- Explain causes of failure and remedial measures for foundations
- Explain the green buildings and suggest how to convert existing building in to green building.

Design based Problems/Open Ended Problems:

1) Setting out of foundation from lay out plan
2) Site Visit of Manufacturing of brick and reports detail, analysis of bricks N B C.
3) Preparing model of following roof works: North Light truss, Lean to Roofs, King post Truss, Queen Post Truss
4) Preparing Model of Various types of Stairs

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