Course No.	Course Name	L-T-P – Credits	Year of Introduction
CE201	MECHANICS OF SOLIDS	3-1-0-4	2016

Pre requisite: BE 100 Engineering Mechanics

Course Objectives: To enable the students to calculate stresses and strains generated in material due to external loads for various types of loading conditions

Syllabus: Concept of stress. Concept of strain. Stress-strain relations. Calculating internal forces (Normal force, shear force and bending moment diagrams) Behavior of axially loaded members. Behavior of members subjected to bending moments. Behavior of circular members subjected to Torsion. Shear stresses in beams. Transformation of plane stresses. Mohr circle. Concept of design of beams. Buckling of columns. Indeterminacy.

Expected outcome .

1. Ability to calculate internal forces in members subject to axial loads, shear, torsion and bending and plot their distributions
2. Ability to calculate normal, shear, torsion and bending stresses and strains
3. Ability to transform the state of stress at a point and determine the principal and maximum shear stresses using equations as well as the Mohr's circle
4. Understanding of column buckling and ability to calculate critical load and stress

Text Books:

1. Timoshenko , Strength of Materials Vol. I & Vol. II , CBS Publishers & Distributers, New Delhi
2. Rattan, Strength of Materials 2e McGraw Hill Education India 2011

Data Book (Approved for use in the examination): Nil

References:

1. Crandall, An Introduction to Mechanics of Solids 3e McGraw Hill Education India 2014
2. Egor P Popov , Mechanics of solids, Prentice Hall of India, New Delhi
3. M.L. Gambhir, Fundamentals of structural Mechanics and analysis, Prentice Hall India
4. Stephen H Crandall, N C Dahi, Thomas J L, M S Sivakumar, an introduction to Mechanics of Solids , McGraw hill Education, 3rd edition
5. Cheng, Statics and Strength of Materials 2e McGraw Hill Education India 2013
6. Hearn E.J., *Mechanics of Materials*, Pergamon Press, Oxford
7. Nash W A, Strength of Materials (SIE) (Schaum's Outline Series) 5e McGraw Hill Education India 2010
8. Rajput R.K. Strength of Materials, S.Chand&company Ltd., New Delhi
9. James M Gere & Stephen P Timoshenko , Mechanics of Materials , CBS Publishers & Distributers, New Delhi
10. Punmia B. C., A. K. Jain and A. K. Jain, Mechanics of Materials, Laxmi Publications(P) Ltd, New Delhi

Course Plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	**Review of Statics** Types of external loads - internal stresses - normal and shear stresses - strain - Hooke's law - working stress - stress strain diagrams - Poisson's ratio - relationship between elastic constants	9	15%
II	Elongation of bars of constant and varying sections – statically indeterminate problems in tension and compression –Temperature effects – strain energy and complementary energy-strain energy due to tension, compression and shear	9	15%
FIRST INTERNAL EXAMINATION			
III	**Bending Moment & Shear force:** Different types of beams- various types of loading –Relationship connecting intensity of loading , shearing force and bending moment- shear force and bending moment diagrams for cantilever beams and Simply supported beams for different types of loading.	9	15%
IV	**Stresses in beams of symmetrical cross sections:** Theory of simple bending –assumptions and limitations – Normal stresses in beams- Moment of resistance - beams of uniform strength - beams of two materials – strain energy due to bending - shearing stresses in beams.	9	15%
SECOND INTERNAL EXAMINATION			
V	**Analysis of stress and strain on oblique sections:** Stress on inclined planes for axial and biaxial stress fields - principal stresses - Mohr's circle of stress **Thin and Thick Cylinders:** Stresses in thin cylinders – thick cylinders - Lame's equation – stresses in thick cylinders due to internal and external pressures **Torsion:** Torsion of solid and hollow circular shafts.-Pure shear- strain energy in pure shear and torsion. **Springs**: Close coiled and open coiled helical springs.	9	20%
VI	**Deflection of statically determinate beams:** Differential equation of the elastic curve - Method of successive integration, Macaulay's method, Method of superposition, moment area method. **Theory of columns:** Direct and bending stresses in short columns- Kern of a section. Buckling and stability-Euler's buckling/crippling load for columns with different end conditions- Rankine's formula	11	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN (End semester exam)

Maximum Marks: 100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A -Module I & II : Answer 2 questions out of 3 questions (15 marks each)

Part B - Module III & IV: Answer 2 questions out of 3 questions (15 marks each)

Part C - Module V & VI: Answer 2 questions out of 3 questions (20 marks each)

Note: 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE202	STRUCTURAL ANALYSIS- I	3-1-0-4	2016

Prerequisite: CE201 Mechanics of Solids

Course objectives:

To equip the students with the comprehensive methods of structural analysis with emphasis on analysis of elementary structures.

Syllabus :

Truss analysis, Displacement response of statically determinate structural systems using energy methods, Principle of virtual work, Statically indeterminate structures, Strain Energy methods, Moving loads and influence lines, Statically determinate and indeterminate suspension bridges and arches.

Course Outcomes:

1. To study about analysis of trusses and to study displacement response of statically determinate structural systems using energy methods:
2. To study application of unit load method and strain energy method for determination of deflection of statically determinate beams, frames & pin jointed trusses
3. Analysis of Statically indeterminate structures using strain energy method and method of consistent deformation
4. To Study about moving loads and influence lines
5. To study about Statically determinate and indeterminate suspension bridges and arches

Text Books:

1. Gere and Timoshenko, Mechanics of materials, CBS. Publishers
2. Kenneth Leet,Chia M Uang& Anne M Gilbert., Fundamentals of Structural Analysis, McGraw Hill

References:

1. M.L. Gambhir, Fundamentals of structural Mechanics and analysis, Printice Hall India
2. DevdasMenon, Structural Analysis, Narosa Publications
3. Reddy C.S., Indeterminate Structural Analysis, Tata McGraw Hill
4. Kinney S., Indeterminate Structural Analysis, Oxford & IBH
5. Hibbeler., Structural Analysis, Pearson Education
6. Aslam Kassimali., Structural Analysis, Cenage Learning
7. Timoshenko S.P.& Young D.H., Theory of Structures, McGraw Hill
8. Harry H West & Louis F Geschwindner, Fundamentals of Structural Analysis, Wiley India Publisher
9. Wang C.K., Intermediate Structural Analysis, McGraw Hill
10. R.Vaidyanathan and P.Perumal, Comprehensive Structural Analysis Volume I & II, Laxmi Publications (P) Ltd

Module	Contents	Hours	End Sem.Exam Marks %
I	**TRUSS ANALYSIS:** Analysis of determinate truss-Methods of joints and sections ***Displacement response of statically determinate structural systems using energy methods:*** Elastic theorems and energy principles - strain energy due to axial load, bending moment, shear and torsion - strain energy method, Castigliano's method for deflection	8	15
II	**Principle of virtual work** – Unit load method-Betti"s theorem - Maxwell"s law of reciprocal deflections - principle of least work - application of unit load method and strain energy method for determination of deflection of statically determinate beams, frames - pin jointed trusses - temperature effects, lack of fit. **Statically indeterminate structures:** Degree of static and kinematic indeterminacies - force and displacement method	9	15
FIRST INTERNAL EXAMINATION			
III	**Strain Energy methods:** Analysis of beams, frames and trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement. **Method of Consistent deformations:** Analysis of beams frames and trusses with internal and external redundancy - effect of prestrain, lack of fit, temperature changes, support settlement.	9	15
IV	**Moving loads and influence lines**. Introduction to moving loads - concept of influence lines - influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams - influence lines for forces in beams and trusses analysis for and trusses analysis for different types of moving loads - single concentrated load - several concentrated loads uniformly distributed load shorter and longer than the span.	10	15
SECOND INTERNAL EXAMINATION			
V	***Statically determinate suspension bridges and arches*** Analysis of forces in cables - temperature effects - suspension bridges with three hinged stiffening girders	10	20
VI	***Statically indeterminate suspension bridges and arches.***- theory of arches – Eddy's theorem - analysis of three hinged arches-suspension bridges with two hinged stiffening girders - analysis of two hinged arches - settlement and temperature effects.	10	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester exam)

Maximum Marks: 100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A -Module I & II : Answer 2 questions out of 3 questions (15 marks each)

Part B - Module III & IV: Answer 2 questions out of 3 questions (15 marks each)

Part C - Module V & VI: Answer 2 questions out of 3 questions (20 marks each)

Note: 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE203	FLUID MECHANICS - I	3-1-0-4	2016

Pre requisite : Nil

Course Objectives

1. To understand the basic properties of the fluid, fluid statics, kinematics, and fluid dynamics so as to analyse and appreciate the complexities involved in solving the fluid flow problems.
2. To give an introduction to the fundamentals of fluid flow and its behavior so as to equip the students to learn related subjects and their applications in the higher semesters.
3. To develop the skill for applying the fluid statics, kinematics and dynamics of fluid flow concepts for solving civil engineering problems.

Syllabus

Fluid Statics, Fluid pressure, Buoyancy and floatation, Fluid Kinematics, Dynamics of fluid flow, Flow through orifice and notches, Flow through pipes, Boundary layer, Drag and lift on Immersed bodies

Course Outcomes:

1. Students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium, so as to solve real life problems in fluid mechanics.
2. Students will gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

Text Books

1. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002.
2. Subramanya K., Theory and Applications of Fluid Mechanics, Tata McGraw-Hill, 1993.

References

1. Streeter.V.L. Fluid Mechanics, Mc Graw Hill Publishers.
2. Bruce R Munson, Donald F Young . Fundamentals of Fluid Mechanics, John Wiley & sons, 2011.
3. Jain A. K., Fluid Mechanics, Khanna Publishers, Delhi, 1996.
4. Joseph Katz, Introductory Fluid Mechanics, Cambridge University Press, 2015
5. Arora.K.R. Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Publishers, 2005.
6. Narasimhan S., A First Course in Fluid Mechanics, University Press (India) Pvt. Ltd., 2006.
7. Frank.M.White, Fluid Mechanics, Mc Graw Hill, 2013.
8. Mohanty.A.K. Fluid Mechanics, Prentice Hall, New Delhi, 2011
9. Narayana Pillai,N. Principles of Fluid Mechanics and Fluid Machines, University Press, 2011.
10. Kumar.D.N. Fluid Mechanics and Fluid power Engineering, S.K.Kataria & sons, 2013.

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Fluid properties - density – specific gravity - surface tension and capillarity - vapour pressure - viscosity and compressibility - Classification of Fluids (No questions to be asked) . Fluid statics: Fluid pressure, variation of pressure in a fluid, measurement of pressure using manometers- simple manometers, differential manometers, Pressure head. Forces on immersed plane and curved surfaces. Pressure distribution diagram for vertical surfaces, Practical application of total pressure (spillway gates). Buoyancy and Floatation: Buoyant force, stability of floating and submerged bodies, metacentre and metacentric height, Analytical and experimental determination of metacentric height.	8	15
II	Kinematics of fluid flow: Methods of describing fluid motion, Lagrangian and Eulerian methods, Types of fluid flow: steady and unsteady flow, uniform and non-uniform flow, one, two and three dimensional flow, laminar and turbulent flow, rotational and irrotational flow. Types of flow lines: stream line, path line, streak lines, conservation of mass, equation of continuity in one, two and three dimensions, (Derivation in Cartesian co-ordinate system only) Velocity & Acceleration of fluid particle, convective and local acceleration, Deformation of fluid elements: circulation and vorticity, velocity potential, stream function, equipotential lines, flow net, uses of flow net; Vortex motion, free and forced vortex (no problems).	8	15
FIRST INTERNAL EXAMINATION			
III	Dynamic of fluid flow: Euler's equation of motion and integration of Euler's equation of motion along a streamline. Bernoulli's Equation, Energy correction factors, Applications of Bernoulli's equation : Pitot tube, Venturimeter and orifice meter. Momentum Principle- Steady flow momentum equation- Momentum correction factor, Force computation on a pipe bend	8	15
IV	Flow through orifices: Different types of orifices, Flow over a sharp edged orifice, Hydraulic coefficients – Experimental determination of these	8	15

	coefficients, flow through large rectangular orifice, Flow through submerged orifices, flow under variable heads, time of emptying. Flow over weirs: flow over rectangular, triangular and trapezoidal sharp crested weir, Cipolletti weir, Broad crested weir, Submerged weirs, Proportional weir.		
SECOND INTERNAL EXAMINATION			
V	Flow through pipes: Viscous flow - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen Poiseulle's Eqn) - Hydraulic and energy gradient - flow through pipes - Darcy -Weisbach's equation - pipe roughness -friction factor- Moody's diagram- Major and minor losses of flow in pipes - Pipes in series and in parallel.	12	20
VI	Boundary layer theory-no slip condition, boundary layer thickness, boundary layer growth over long thin plate, laminar, turbulent boundary layer, laminar sub layer, Momentum integral equation of boundary layer (no derivation), Blasius boundary layer equations for laminar and turbulent boundary layer. Drag and lift on Immersed bodies-Pressure drag and friction drag, profile drag, Drag and lift co-efficient-computation of drag on a flat plate. Separation of boundary layer and control.	12	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester exam)

Maximum Marks: 100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A - Module I & II : Answer 2 questions out of 3 questions (15 marks each)

Part B - Module III & IV: Answer 2 questions out of 3 questions (15 marks each)

Part C - Module V & VI: Answer 2 questions out of 3 questions (20 marks each)

Note: 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed.

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Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE204	CONSTRUCTION TECHNOLOGY	4-0-0-4	2016

Prerequisite : Nil

Course objectives:

1. To study details regarding properties and testing of building materials,
2. To study details regarding the construction of building components
3. To study properties of concrete and concrete mix design
4. To impart the basic concepts in functional requirements of building and building services.
5. To develop understanding about framed construction and building failures

Syllabus:

Construction Materials – Building stones –. Timber -Mortar – Iron and Steel –. Structural steel – Modern materials. Concrete–Admixtures –Making of concrete -Properties of concrete– mix proportioning

Building construction - foundations –Masonry – Lintels and arches –Floors and flooring – Roofs and roof coverings -Doors, windows and ventilators -Finishing works .Tall Buildings – steel and concrete frame –prefabricated construction – slip form construction. Vertical transportation – Stairs –Elevators – escalators –ramps.

Introduction to Cost-effective construction - Building failures –failures in RCC and Steel structures– Foundation failure

Course Outcomes:

1. Ability to describe Construction materials, their components and manufacturing process
2. To equip with the properties of concrete and different mix design methods
3. Ability to understand the details regarding the construction of building components
4. Analyse and apply learning of materials, structure, servicing and construction of masonry domestic buildings.
5. Define and describe the concepts and design criteria of tall framed and load bearing buildings.

Text books

1. Rangwala S C., Engineering Materials, Charotar Publishers
2. Punmia B. C, Building construction. Laxmi Publications

Reference Books

1. Gambhir M L, Concrete Technology, Tata McGrawHill.
2. Krishna Raju N, Design of Concrete Mixes, CBS publishers.
3. Neville A.M. and Brooks.J.J, Concrete Technology, Pearson Education.
4. G c Sahu & Joygopal Jena., Building Materials and construction, McGraw Hill Education
5. National Building Code.
6. Smith P & Julian W. Building services, Applied Science Pub.
7. Mcking T.M, Building Failures, Applied Science Pub.
8. Shetty M.S., Concrete Technology, S. Chand & company.
9. Arora and Bindra, Building construction, Dhanpath Rai and Sons.
10. Adler R, Vertical Transportation for Building, American Elsevier Pub.
11. Tall building systems & concepts, Monograph on planning and design of Tall building,

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem.Exam Marks %**
I	**Construction Materials** – **Building stones** – Classification of rocks – Quarrying of stones. Dressing – Properties and uses of common stones – Tests conducted on stones. **Timber** – Classification – seasoning -defects in Timber — decay– preservation – Manufacture, properties and uses of plywood, fibre board, particle board. **Mortar** – Types – Sand – properties – uses. **Iron and Steel** –Reinforcing steel – types – specifications. **Structural steel** – specifications **Miscellaneous materials** (only properties, classifications and their use in construction industry): Glass, Plastics, A.C. Sheets, Bitumen, Adhesives, Aluminium	8	15
II	**Concrete** – Aggregates – Mechanical & Physical properties and tests – Grading requirements – Water quality for concrete – **Admixtures** – types and uses – plasticizers – accelerators – retarders –water reducing agents **Making of concrete** - batching – mixing – types of mixers – transportation – placing – compacting – curing **Properties of concrete** – fresh concrete – workability – segregation and bleeding - factors affecting workability & strength – tests on workability – tests for strength of concrete in compression, tension & flexure **Concrete quality control** – statistical analysis of results – standard deviation –acceptance criteria – **mix proportioning** (B.I.S method) – nominal mixes.	10	15
FIRST INTERNAL EXAMINATION			

III	**Building construction** - Preliminary considerations –Foundations - shallow and deep foundations – description of spread, grillage, raft and pile foundation. **Masonry** – Types of stone masonry – Bonds in brickwork – advantages and limitations of masonry construction - corbels, cornice and copings composite walls - cavity walls and partition walls – construction details and features – scaffoldings.	9	15
IV	**Lintels and arches** – types and construction details. **Floors and flooring** – different types of floors and floor coverings **Roofs and roof coverings** – different types of roofs – suitability – types and uses of roofing materials **Doors, windows and ventilators** – Types and construction details **Finishing works** – Plastering, pointing, white washing, colour washing, distempering, painting. Methods of providing DPC. Termite proofing	10	15
SECOND INTERNAL EXAMINATION			
V	**Tall Buildings –** Framed building – steel and concrete frame – structural systems –erection of steel work–concrete framed construction– formwork – construction and expansion. joints Introduction to prefabricated construction – slip form construction **Vertical transportation –Stairs** – types - layout and planning.- **Elevators** – types – terminology – passenger, service and goods elevators – handling capacity - arrangement and positioning of lifts – **Escalators** – features –use of ramps	9	20
VI	**Introduction to Cost-effective construction -** principles of filler slab and rat-trap bond masonry **Building failures –** General reasons – classification – Causes of failures in RCC and Steel structures **Foundation failure** – failures by alteration, improper maintenance, overloading – Fire, Wind and Earthquake.	9	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester exam) :

Maximum Marks :100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A -Module I & II : Answer 2 questions out of 3 questions (15 marks each)

Part B - Module III & IV: Answer 2 questions out of 3 questions (15 marks each)

Part C - Module V & VI : Answer 2 questions out of 3 questions (20 marks each)

Note : 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE205	ENGINEERING GEOLOGY	3-0-1-4	2016

Prerequisite: NIL

Course Objectives

Awareness about earth resources and processes to be considered in various facets of civil engineering

1. Appreciation of surface of earth as the fundamental foundation structure and the natural phenomena that influence its stability

Syllabus :

Relevance of geology in Civil Engineering. Subdivisions of Geology. Interior of the earth. Weathering, its engineering significance and laboratory tests used in civil engineering. Soil profile.
Hydrogeology-occurrence of groundwater, Types of aquifers and their properties. Engineering significance of subsurface water in construction. Methods to control of subsurface water.
Minerals- Properties that affect the strength of minerals. Physical properties and chemical composition of common rock forming minerals
Earth quakes- in relation to internal structure of earth and plate tectonics
Types of rocks. Brief account of selected rocks. Rock features that influence the strength of rocks as construction material. Rock types of Kerala. Engineering properties of rocks.
Attitude of geological structures- strike and dip. Deformation structures and their engineering significance. Geological factors considered in the construction of engineering structures.
Introduction to natural hazards and their management. Coastal Processes and protection strategies. Soil erosion and conservation measures.

Expected Outcomes:

1. The course would help the student to understand of the factors that determine the stability of earth's surface
2. The student would comprehend better the earth resources used as building materials

Text Books / References:

1. Duggal, SK,Rawal,N and Pandey, HK (2014) Engineering Geology, McGraw Hill Education, New Delhi
2. Garg, SK (2012) Introduction to Physical and Engineering Geology, Khanna Publishers, New Delhi
3. Gokhale, KVGK (2010) Principles of Engineering Geology, BS Pubications, Hyderabad
4. Kanithi V (2012) Engineering Geology, Universities Press (India) Ltd., Hyderabad
5. Singh, P (2004) Engineering and General Geology, S. K. Kataria and Sons, New Delhi
6. Bennison, GM, Olver, PA and Moseley, KA (2013) An introduction to geological structures and maps, Routledge, London
7. Gokhale, NW (1987) Manual of geological maps, CBS Publishers, New Delhi

COURSE PLAN			
Module	**Contents**	**Hours**	**End Sem.Exam Marks %**
I	Relevance of geology in Civil Engineering. Subdivisions of Geology. Weathering, types and its engineering significance. Laboratory tests used in civil engineering for assessing intensity of weathering. Engineering classification of weathered rock masses. Soil profile. Geological classification of soils.	8	15
II	Hydrogeology-occurrence of groundwater, Types of aquifers, permeability / hydraulic conductivity. Engineering significance of subsurface water-problems created in construction, as an erosional agent. Methods to control of subsurface water-barriers and liners, drains and wells.(Resistivity survey of groundwater may be demonstrated)	11	15
FIRST INTERNAL EXAMINATION			
III	Minerals- Properties that affect the strength of minerals. Physical properties and chemical composition of following minerals -quartz, feldspars (orthoclase and plagioclase), micas (biotite and muscovite), amphibole (hornblende), pyroxene (augite and hypersthene), gypsum, calcite, clay minerals (kaolinite), their chemical formulae. Earth quakes- in relation to internal structure of earth and plate tectonics	8	15
IV	Rocks as aggregates of minerals. Basic concepts-igneous, sedimentary and metamorphic rocks, Brief account of following rocks- granite, basalt, sandstone, limestone, shale, marble and quartzite. Rock features that influence the strength of rocks as construction material-concepts of lineation and foliation-schistosity and gneissosity. Rock types of Kerala. Brief account of engineering properties of rocks used as construction material (building and foundation) and road aggregates. Assessment of these properties.(Students should be taught to identify common rock forming minerals and common rocks based on their physical properties).	10	15
SECOND INTERNAL EXAMINATION			
V	Attitude of geological structures- strike and dip. Brunton compass. Deformation structures and	11	20

	their engineering significance- folds, faults and joints. Geological factors considered in the construction of dams and reservoirs, tunnels. (Simple exercises based on geological/topographic maps for determination of dip, apparent dip and thickness of lithological beds and preparation of geological cross sections should be performed. The students should be instructed in handling clinometer/Brunton compass to determine strike and dip)		
VI	Introduction to natural hazards-Mass movements (Landslides), floods, their common management strategies. Coastal Processes- waves, currents and landforms. Types of coastal protection strategies. Soil erosion- causes and types and soil conservation measures.	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester exam)

Maximum Marks :100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A -Module I & II : Answer 2 questions out of 3 questions (15 marks each)

Part B - Module III & IV: Answer 2 questions out of 3 questions (15 marks each)

Part C - Module V & VI : Answer 2 questions out of 3 questions (20 marks each)

Note : 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE206	FLUID MECHANICS -II	3-0-0-3	2016

Prerequisite : CE203 Fluid Mechanics I

Course objectives

1. Application of the Basic principles and laws governing fluid flow to open channel flow including hydraulic jump & gradually varied flow.
2. An understanding of basic modeling laws in fluid mechanics and dimensional analysis.
3. An ability to apply the fundamental theories of fluid mechanics for the analysis and design of hydraulic machines

Syllabus

Hydraulic machines, Turbines, Pumps, Open channel flow, uniform flow, Hydraulic Jump, Gradually varied flow, Dimensional analysis and model testing.

Expected Outcome

1. The students become capable of analysis of open channel flows & design of open channels.
2. They get an insight into the working of hydraulic machines.
3. They become capable of studying advanced topics such as design of hydraulic structures.

Text Books:

1. Modi P. N. and S. M. Seth, Hydraulics and Fluid Mechanics (Including Hydraulic Machines), Standard Book House, New Delhi, 2013.
2. Narayana Pillai,N. Principles of Fluid Mechanics and Fluid Machines, University Press, 2011.

References:

1. Ven Te Chow, Open channel Hydraulics, 2009.
2. C S P Ojha, P N Chandramouli and R Brendtsson , Fluid Mechanics and Machinery, Oxford University Press , India , New Delhi
3. Hanif Choudhary, Open channel flow, Prentice Hall, 2010
4. Arora.K.R. Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Publishers, 2005.
5. Jain A. K., Fluid Mechanics, Khanna Publishers, Delhi, 1996.
6. Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2010.
7. Subramanya K., Open Channel Hydraulics, Tata McGraw Hill, 2009.

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem.Exam Marks %**
I	Hydraulic Machines - Impulse momentum principle, impact of jets, force of a jet on fixed and moving vanes. Turbines- classification and comparison of velocity triangles for Pelton wheel and reaction turbines (Francis and Kaplan), work done and efficiency, specific speed, draft tube- different types, penstock, surge tank - types, cavitation in turbines.	8	15
II	Pumps- classification of pumps - Centrifugal pumps- types, work done, efficiency, minimum speed, velocity triangle for pumps, specific speed, priming, limitation of suction lift, net positive suction head, cavitation in centrifugal pump.	6	15
FIRST INTERNAL EXAMINATION			
III	Introduction: Open channel flow and its relevance in Civil Engineering , Comparison of open channel flow and pipe flow . Flow in open channels-types of channels, types of flow, geometric elements of channel section, velocity distribution in open channels, uniform flow in channels, Chezy's equation, Kutter's and Bazin's equations, Manning's formula, Most economic section for rectangular, trapezoidal and triangular channels. Condition for maximum discharge and maximum velocity through circular channels, computations for uniform flow, normal depth, conveyance of a channel section, section factor for uniform flow.	6	15
IV	Specific energy, critical depth, discharge diagram, Computation of critical flow, Section factor for critical flow. Specific force, conjugate or sequent depths, hydraulic jump, expression for sequent depths and energy loss for a hydraulic jump in horizontal rectangular channels, types of jump, length of jump, height of jump, uses of hydraulic jump.	6	15
SECOND INTERNAL EXAMINATION			
V	Gradually varied flow - dynamic equation for gradually varied flow, different forms of dynamic equation, Approximation for a wide rectangular channel, classification of surface profiles, Backwater and drawdown curves, characteristics of surface profiles in prismatic channels. Computation of length	8	20

	of surface profiles, direct step method. Design of lined open channels : triangular and trapezoidal cross-sections only		
VI	Dimensional analysis and model studies - dimensions, dimensional homogeneity, methods of dimensional analysis, Rayleigh method, Buckingham method, dimensionless numbers, Similitude - geometric, kinematic and dynamic similarities. Model laws - Reynold's and Froude model laws, scale ratios, types of models, distorted and undistorted models, scale effect in models.	8	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester exam)

Maximum Marks :100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A -Module I & II : Answer 2 questions out of 3 questions (15 marks each)

Part B - Module III & IV: Answer 2 questions out of 3 questions (15 marks each)

Part C - Module V & VI : Answer 2 questions out of 3 questions (20 marks each)

Note : 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed.

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE207	SURVEYING	3-0-0-3	2016

Prerequisite : Nil

Course objectives:

- To introduce the principle of surveying
- To impart awareness on the various fields of surveying and types of instruments
- To understand the various methods of surveying and computations

Syllabus: Basics of Surveying, Levelling and Contouring, Area and Volume Computation, Theodolite Survey, Mass Diagram, Triangulation, Theory of Errors, Electronic Distance Measurement, Total Station Survey

Course Outcomes: After successful completion of the course, the students will possess knowledge on the basics of surveying and different methods of surveying

Text Books :

1. Prof. T.P.Kenetkar & Prof.S.V.Kulkarni - Surveying and Levelling , Pune Vidyarthi Griha Prakashan,2004
2. N N Basak, Surveying and Levelling, Mc GrawHill Education

References :

1. R.Agor - A Text book of Surveying and Levelling, Khanna Publishers, 2005
2. C. Venkatramaiah, Textbook of Surveying, Universities Press (India) Private Limited 2011
3. James M Andersen, Edward M Mikhail, Surveying Theory and Practice, McGraw Hill Education
4. Dr. B.C.Punmia , Ashok Kumar Jain &Arun Kumar Jain - Surveying , Laxmi publications (P)Ltd , 2005
5. S.K.Duggal - Surveying Vol. I, Tata Mc Graw Hill Ltd ,Reprint 2015.

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem.Exam Marks %**
I	**Introduction to Surveying-** Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Local attraction, Declination, Dip, Latitude and Departure, Methods of orientation, Principle of resection	7	15
II	**Levelling:** Principles of levelling- Dumpy level- booking and reducing levels, Methods- simple, differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling **Contouring**: Characteristics, methods, uses.	7	15
FIRST INTERNAL EXAMINATION			
III	**Area and Volume**: Various methods of computation. **Theodolite survey**: Instruments, Measurement of horizontal and vertical angle. **Mass diagram**: Construction, Characteristics and Uses.	6	15
IV	**Triangulation:** Triangulation figures, Strength of figure, Triangulation stations, Inter visibility of stations, Towers and signals – Satellite Stations and reduction to centre.	8	15
SECOND INTERNAL EXAMINATION			
V	**Theory of Errors** – Types, theory of least squares, Weighting of observations, Most probable value, Application of weighting, Computation of indirectly observed quantities - method of normal equations.	8	20
VI	**Electromagnetic distance measurement (EDM) –** Principle of EDM, Modulation, Types of EDM instruments, Distomat **Total Station –** Parts of a Total Station – Accessories – Advantages and Applications, Introduction to Astronomical terms, Field Procedure for total station survey, Errors in Total Station Survey.	6	20
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester exam) :

Maximum Marks :100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE208	GEOTECHNICAL ENGINEERING - I	3-0-0 -3	2016

Prerequisite : CE 205 Engineering Geology

Course objectives:

1. To impart to the students, the fundamentals of Soil Mechanics principles;
2. To enable the students to acquire proper knowledge about the basic, index and engineering properties of soils.

Syllabus:

Major soil deposits of India, Basic soil properties, Relationship between basic soil properties, Index properties-Sieve analysis, Hydrometer analysis, Atterberg Limits and Relative density, Soil classification, Permeability of soils, Principle of effective stress, Quick sand condition, Critical hydraulic gradient, Shear strength of soils, Mohr-Coulomb failure criterion, Different types of shear tests, Liquefaction of soils, Compressibility and Consolidation, Void ratio versus pressure relationship, Normally consolidated, under consolidated and over consolidated states, Estimation of magnitude of settlement, Terzaghi's theory of one-dimensional consolidation, Coefficient of consolidation , Stability of finite slopes, Swedish Circle Method- Friction circle method ,use of Stability, Compaction of soils, light and heavy compaction tests , Control of compaction

Course Outcomes:

1. The students will be able to understand the basic principles governing soil behavior.
2. The students will be able to understand the procedure, applicability and limitations of various soil testing methods.

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.

2. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.

References:

1. Taylor D.W., Fundamentals of Soil Mechanics, Asia Publishing House, 1948.

2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.

3. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.

4. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.

5. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Kindersley(India) Pvt. Ltd., 2013

6. A V Narasimha Rao and C Venkatramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem.Exam Marks %**
I	Introduction to soil mechanics -Major soil deposits of India Basic soil properties - Void ratio, porosity, degree of saturation, air content, percentage air voids, moisture content, specific gravity, unit weight - Relationship between basic soil properties – Sensitivity – Thixotropy - numerical problems	6	15%
II	Index properties - Sieve analysis – Well graded, poorly graded and gap graded soils - Stoke's law - Hydrometer analysis(no derivation required for percentage finer and diameter) - numerical problems- – Relative density Consistency-Atterberg Limits - Practical Applications - numerical problems I.S. classification of soils.	7	15%
FIRST INTERNAL EXAMINATION			
III	Permeability of soils - Darcy's law – Factors affecting permeability - Practical Applications - Constant head and falling head permeability tests - Average permeability of stratified deposits (no derivation required) - numerical problems. Principle of effective stress - Total , neutral and effective stress variation diagrams - Quick sand condition - Critical hydraulic gradient - - numerical problems– Definition of phreatic line and exit gradient.	6	15%
IV	Shear strength of soils- Practical Applications - Mohr-Coulomb failure criterion – Mohr circle method for determination of principal planes and stresses- numerical problems – relationship between shear parameters and principal stresses[no derivation required} Brief discussion of direct shear test, tri-axial compression test, vane shear test and unconfined compression test – Applicability - numerical problems -UU and CD tests [Brief discussion only] - Liquefaction	7	15%

SECOND INTERNAL EXAMINATION			
V	Compressibility and Consolidation - Void ratio versus pressure relationship - Coefficient of compressibility and volume compressibility – Compression index Practical Applications - Change in void ratio method - Height of solids method -Normally consolidated, under consolidated and over consolidated states - Estimation of pre consolidation pressure - Practical Applications - Estimation of magnitude of settlement of normally consolidated clays - Numerical problems Terzaghi's theory of one-dimensional consolidation(no derivation required) - average degree of consolidation – Time factor - Coefficient of consolidation - Practical Applications -Square root of time and logarithm of time fitting methods - Numerical problems	8	20%
VI	Stability of finite slopes - Toe failure, base failure, slip failure - Swedish Circle Method- Friction circle method- Factor of safety with respect to cohesion and angle of internal friction - Stability number - Stability charts - Methods to improve slope stability. Compaction of soils - Standard Proctor, Modified Proctor, I.S. light & Heavy Compaction Tests – OMC - Zero Air voids line - Control of compaction - numerical problems	8	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN (End semester exam) :

Maximum Marks :100 Exam Duration: 3 Hrs

The question paper shall have three parts.

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note : 1.Each part should uniformly cover the two modules in that part.

2. Each question can have a maximum of 4 subdivisions (a,b,c,d), if needed

Course No.	Course Name	L-T-P-Credits	Year of Introduction
CE230	MATERIAL TESTING LAB	0-0-3-1	2016

Course Objectives:

1. To provide knowledge on mechanical behaviour of materials
2. To acquaint with the experimental methods to determine the mechanical properties of materials.

Syllabus

List of experiments:

1. Tension test on mild steel/ tor-steel/ high strength steel and cast iron using Universal Testing Machine and extensometers.
2. Tests on springs (Open and closed coiled)
3. Torsion pendulum (mild steel, aluminium and brass wires)
4. Hardness test (Brinell, Vickers and Rockwell)
5. Impact test (Izod and Charpy)
6. Torsion test on mild steel rods.
7. Shear test on mild steel rods.
8. Fatigue test – Study of testing machine.
9. Bending test on wooden beams.
10. Strut test (Column buckling experiment)
11. Verification of Clerk Maxwell's law of reciprocal deflection and determination of Young's modulus of steel.
12. Photo elastic methods for stress measurements.
13. Jominy hardenability test
14. Measurement using strain gauges
15. Determination of moment of inertia of rotating bodies

Note: A minimum of 10 experiments are mandatory.

Expected outcome: At the end of the course the students will be able to

1. Acquire the knowledge on mechanical behaviour of materials
2. Conduct experiments determine the mechanical properties of materials.

References Books:

1. G E Dieter. Mechanical Metallurgy, McGraw Hill,2013
2. Dally J W, Railey W P, Experimental Stress analysis , McGarw Hill,1991
3. Baldev Raj, Jayakumar T, Thavasimuthu M., Practical Non destructive testing, Narosa Book Distributors,2015

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CE231	CIVIL ENGINEERING DRAFTING LAB	0-0-3-1	2016

Prerequisite : BE 110 - Engineering Graphics

Course Objectives :

1. To introduce the fundamentals of Civil Engineering drawing.
2. To understand the principles of planning
3. To learn drafting of buildings.
4. To impart knowledge on drafting software such as AutoCAD.

List of Exercises : (at least 10 exercises / plates are mandatory **)**

1. Paneled Doors
2. Glazed Windows and Ventilators in wood
3. Steel windows
4. Roof truss in steel sections
5. Reinforced concrete staircase
6. Residential buildings with flat roof
7. Residential buildings with tiled roof
8. Preparation of site plan and service plans as per building rules
9. Building Services (for single and two storied buildings only). Septic tanks and soak pit detailed drawing
10. Two storied and multi storied buildings
11. Public buildings like office, dispensary, post office, bank etc.
12. Industrial buildings with trusses

Expected outcome.

To accomplish the abilities/skills for the following.

1. To understand the drawings of various components of buildings
2. Preparation of building drawings.
3. Interpretation of building drawings.
4. Use of a drafting software.

Text Books:

1. National Building Code of India.
2. Kerala Municipal Building Rules.
3. Dr. Balagopal T.S. Prabhu, Building Drawing and Detailing, Spades Publishers, Calicut
4. AutoCAD Essentials, Autodesk official Press, John Wiley & Sons, USA

References:

1. Shah, M.G., Kale, C. M. and Patki, S.Y. Building Drawing With An Intergrated Approach to Built Environment, Tata McGraw Hill Publishing Company Limited, New Delhi

Points to note:

1. Equal weightage to be given for manual drafting and drafting using computer aided drafting software.
2. Evaluation of drawing, along with a viva-voce, to be done at the end of every day class.

Internal Continuous Evaluation - 100 marks

Best 10 plates - 60 marks

Viva-voce - 10 marks

Final Examination - 30 marks

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE232	MATERIAL TESTING LAB -I	0-0-3-1	2016

Prerequisite : CE201 Mechanics of Solids

Course objectives:
The experimental work involved in this laboratory should make the student understand the fundamental modes of loading of the structures and also make measurements of loads, displacements and strains. Relating these quantities, the student should be able to obtain the strength of the material and stiffness properties of structural elements.

Course Outcomes:
The students will be able to undertake the testing of materials when subjected to different types of loading.

List of Experiments: (10 Experiments mandatory)

1. Tension test on Structural Materials: Mild Steel and Tor steel (HYSD bars) (Universal Testing machine and suitable extensometer)
2. Shear test on mild steel rod (Compression Testing Machine and Shear Shackle)
3. Bending test on mild steel (I sections) (Universal Testing Machine)
4. Torsion test on Mild steel circular bars (Torsion Testing Machine)
5. Torsion test on Steel/Copper/ Aluminum wires
    a. Using Torsion Pendulum with Central disk
    b. Using Torsion Pendulum with distributed Mass
6. Impact test
    a. Izod test (Impact Testing Machine)
    b. Charpy test (Impact Testing Machine)
7. Hardness test
    a. Brinell Hardness test (Brinnel Hardenss Testing Machine)
    b. Rockwell Hardness test (Rockwell Hardness Testing Machine)
    c. Vickers Hardness test (Vickers Hardness Testing Machine)
8. Test On Springs
    a. Open coil (Spring Testing Machine)
    b. Close coil (Spring Testing Machine)
9. Bending Test on Timber (Universal Testing Machine and dial Gauge)
10. Bend & Rebend test on M S Rods
11. Verification of Clerk Maxwells Theorem
12. Demonstration of Fatigue Test
13. Study/demonstration of Strain Gauges and load cells

Books/Manuals /References:-

1. Testing of Engineering Materials by George E Troxell, Harmer E Davis, G Hauck,McGraw-Hill,Newyork
2. Testing of Metallic Materials by Prof. A V K Suryanaraya, Prentice Hall, India, Pvt Ltd.
3. Mechanical Behavior of Materials, by N Dowling,Prentice Hall, 1993.

Internal Continuous Evaluation - 100 marks

Record/output (Average) - 60 marks Viva-voce (Average) - 10 marks

Final practical exam – 30 marks

Course No.	Course Name	L-T-P - Credits	Year of Introduction
CE233	SURVEYING LAB	0-0-3-1	2016

Prerequisite : Nil

Course Objectives:

1. To equip the students to undertake survey using tacheometer
2. To equip the students to undertake survey using total station
3. To impart awareness on distomat and handheld GPS

List of Exercises/Experiments : (10 to12 exercises are mandatory)

1. Introduction to conventional surveying -1 class
2. Levelling (dumpy level) -2 class
3. Theodolite surveying (Theodolite) -3class
4. Total Station survey (Total Station) -5 class
   a. Heights and Distance
   b. Area computation
   c. Downloading
5. Study of instruments –Automatic level, digital level, Handheld GPS -2 class
6. Test -2 class

Expected outcome .

Ability to undertake survey using level and theodolite and total station

Internal Continuous Evaluation - 100 marks

Record/output (Average) - 60 marks

Viva-voce (Average) - 10 marks

Final practical examination – 30 marks

Course Code	Course Name	L-T-P-Credits	Year of Introduction
CE234	FLUID MECHANICS LABORATORY	0-0-3-1	2016

Prerequisite : CE203 Fluid Mechanics- I

Course objectives

1. Students should be able to verify the principles studied in theory by performing the experiments in laboratory

Expected Outcome

1. The students will be able to understand the different flow measurement equipment's and their procedures.
2. The students will be able to analyze the performance characteristics pumps/turbines.
3. Able to develop the skill of experimentation techniques for the study of flow phenomena in channels/pipes.

List of Experiments (Minimum 12 nos. mandatory)

1. Study of taps, valves, pipe fittings, gauges, pitot tubes, water meters and current meters.
2. Calibration of Pressure gauges
3. Determination of metacentric height and radius of gyration of floating bodies.
4. Verification of Bernoulli's theorem
5. Hydraulic coefficients of orifices and mouth pieces under constant head method and time of emptying method.
6. Calibration of Venturimeter.
7. Calibration of Orifice meter
8. Calibration of water meter.
9. Calibration of rectangular and triangular notches.
10. Time of Emptying : unsteady flow
11. Determination of Darcy's and Chezy's constant for pipe flow.
12. Determination of Chezy's constant and Manning's number for open channel flow.
13. Plotting Specific Energy Curves in Open Channel flow
14. Study of Parameters of Hydraulic Jump in Open channel Flow.
15. Determination of friction co-efficient in pipes
16. Determination of loss co-efficient for pipe fittings

17. Performance characteristics of centrifugal pump.
18. Performance characteristics of Pelton wheel.
19. Performance characteristics of Francis turbine.
20. Performance characteristics of Kaplan turbine.

Internal Continuous Evaluation - 100 marks

Record/output (Average) - 60 marks

Viva-voce (Average) - 10 marks

Final practical exam -30 marks

Course code	Course Name	L-T-P-Credits	Year of Introduction
CE336	STRENGTH OF MATERIALS LAB	0-0-3-1	2016

Prerequisite : SB201 Mechanics of solids

Course Objectives:

- To study various types of failures occurring in service life of ductile metals.
- Provide an environment to enable students to correlate theoretical knowledge gained in the class room with the physical world.
- To study the properties of various materials under various working conditions.

List of Exercises/ Experiments (Minimum 12 Mandatory)

1. Tests on Open Coiled Spring
   Equipment: Spring Testing Machine, Vernier Calliper.
2. Tests on Closed Coiled Spring
   Equipment: Spring Testing Machine, Vernier Calliper.
3. Bending Test on Wooden Beams Using U. T. M.
   Equipment: Universal Testing Machine, Deflection Gauges, Measuring Tape.
4. Verification of Clerk Maxwell's Law of Reciprocal Deflection and Determination of Young's Modulus 'E' for Steel.
   Equipment: Apparatus for verification of Clerk Maxwell's Law of Reciprocal Theorem, Deflection gauges, Weights, Scale, Vernier Calliper.
5. Torsion Pendulum Test for M.S. wires.
   Equipment: Torsion Pendulum, Cylindrical Weights, Stop Watch.
6. Torsion Pendulum Test for Aluminium Wires.
   Equipment: Torsion Pendulum, Cylindrical Weights, Stop Watch.
7. Torsion Pendulum Test for Brass Wires.
   Equipment: Torsion Pendulum, Cylindrical Weights, Stop Watch.
8. Tension Test Using U. T. M. on M. S. Rod.
   Equipment: Universal Testing Machine, Deflection gauges, Measuring Tape, Vernier Caliper.
9. Tension Test Using U. T. M. on Torsteel rod
   Equipment: Universal Testing Machine, Deflection gauges, Measuring Tape, Vernier Caliper.
10. Tension Test Using U. T. M. on High Tensile Steel rod.
    Equipment: Universal Testing Machine, Deflection gauges, Measuring Tape, Vernier Caliper.
11. Compression test on concrete specimen.
    Equipment: Compression Testing Machine.
12. Compression test on brick.
    Equipment: Compression Testing Machine.
13. Torsion Test on M. S. Rod.
    Equipment: Torsion Testing Machine, Vernier Caliper.
14. Shear Test on M.S. Rod.
    Equipment: Universal Testing Machine, Deflection gauges, Measuring Tape, Vernier Caliper.
15. Impact Test Using Izod Apparatus and Charpy.
    Equipment: Charpy/ Izod Impact Testing Machine.
16. Impact Test Using Charpy Apparatus
    Equipment: Charpy/ Izod Impact Testing Machine.

17. Hardness Test using Brinell Hardness Apparatus
    Equipment: *Brinell Hardness Testing Machine.*
18. Strut Test.
    Equipment: *Strut Testing Machine, Vernier Calliper.*

Course Outcome:

Upon successful completion of the course, the student will be:

i. Familiar with the arrangement and conduct of experiments in the Material Testing laboratory environment.
ii. Able to note down relevant readings and perform calculations while an experiment is in progress thereby correlating theoretical concepts of materials and their practical implications..
iii. Able to comprehend the factors responsible for variation between theoretical and experimental results pertaining to the domain of Material Science.

Text books:

1. R.K. Bansal; Strength of Materials; Laxmi Publications.
2. Wonsiri Punurai; Mechanics of Materials-Laboratory and Experiments; LAP LAMBERT Academic Publishing.