| Item No: 125 |
| --- |
| AC- 23/7/2020 |

# UNIVERSITY OF MUMBAI

## Bachelor of Engineering

**in**

## Civil Engineering

**Second Year with Effect from AY 2020-21**
**Third Year with Effect from AY 2021-22**
**Final Year with Effect from AY 2022-23**

**(REV- 2019 'C' Scheme) from Academic Year 2019 – 20**

**Under**

# FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

Item No: -125
AC- 23/7/2020

# UNIVERSITY OF MUMBAI

## Syllabus for Approval

| Sr. No. | Heading | Particulars |
|---|---|---|
| 1 | Title of the Course | **Second Year B.E. Civil Engineering** |
| 2 | Eligibility for Admission | **After Passing First Year Engineering as per the Ordinance 0.6242** |
| 3 | Passing Marks | **40%** |
| 4 | Ordinances / Regulations ( if any) | **Ordinance 0.6242** |
| 5 | No. of Years / Semesters | **8 semesters** |
| 6 | Level | **U.G.** |
| 7 | Pattern | **Semester** |
| 8 | Status | **New** |
| 9 | To be implemented from Academic Year | **With effect from Academic Year: 2020-2021** |

Date

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

# Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

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Associate Dean
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# Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of ‘C ‘ scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme ‘A' and ‘B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD’s/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

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Dr Anuradha Muzumdar
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Faculty of Science and Technology
University of Mumbai

# Preface

The engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program Outcomes (POs) are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education (OBE) in the process of curriculum development from Rev-2012 onwards and continued to enhance the curriculum further based on OBE in Rev-2016 and Rev-2019 "C" scheme.

As Chairman and Members of Board of Studies in Civil Engineering, University of Mumbai, we are happy to state here that, the Program Educational Objectives (PEOs) for Undergraduate Program were finalized in a brain storming sessions, which was attended by more than 40 members from different affiliated Institutes of the University, who are either Heads of Departments or their senior representatives from the Department of Civil Engineering. The PEOs finalized for the undergraduate program in Civil Engineering are listed below;

1. To prepare the Learner with a sound foundation in mathematical, scientific and engineering fundamentals
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems
3. To prepare the Learner for a successful career in Indian and Multinational Organisations and for excelling in post-gradute studies
4. To motivate learners for life-longing learning
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process

In addition to the above listed PEOs, every institute is encouraged to add a few (2-3) more PEOs suiting their institute vision and mission

Apart from the PEOs, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of OBE. We strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

**Board of Studies in Civil Engineering, University of Mumbai**

| | |
|---|---|
| 1. Dr. S. K. Ukarande: | Chairman |
| 2. Dr. K. K. Sangle: | Member |
| 3. Dr. S. B. Charhate: | Member |
| 4. Dr. A. R. Kambekar: | Member |
| 5. Dr. R. B. Magar: | Member |
| 6. Dr. Seema Jagtap: | Member |

**Program Structure for Second Year Engineering**
**Semester III & IV**
**UNIVERSITY OF MUMBAI**
**(With Effect** from **2020-2021**)

# Semester - III

| **Course Code** | **Course Name** | **Teaching Scheme (Contact Hours)** | | | **Credits Assigned** | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| CEC301 | Engineering Mathematics-III | 3 | - | 1 | 3 | - | 1 | 4 |
| CEC302 | Mechanics of Solids | 4 | | | 4 | | | 4 |
| CEC303 | Engineering Geology | 3 | | | 3 | | | 3 |
| CEC304 | Architectural Planning & Design of Buildings | 2 | - | - | 2 | - | - | 2 |
| CEC305 | Fluid Mechanics- I | 3 | - | - | 3 | - | - | 3 |
| CEL301 | Mechanics of Solids | - | 2 | - | - | 1 | - | 1 |
| CEL302 | Engineering Geology | - | 2 | - | - | 1 | - | 1 |
| CEL303 | Architectural Planning & Design of Buildings | - | 2 | - | - | 1 | - | 1 |
| CEL304 | Fluid Mechanics- I | - | 2 | - | - | 1 | - | 1 |
| CEL305 | Skill Based Lab Course-I | | 3 | | - | 1.5 | | 1.5 |
| CEM301 | Mini Project – 1 A | - | 3[$] | - | - | 1.5 | - | 1.5 |
| **Total** | | **15** | **14** | **1** | **15** | **7** | **1** | **23** |

| **Examination Scheme** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **Internal Assessment** | | | **End Sem Exam** | **Exam Duration (Hrs.)-** | **Term Work** | **Prac. /Oral** | **Total** |
| | | Test I | Test II | Avg. | | | | | |
| CEC301 | Engineering Mathematics-III | 20 | 20 | 20 | 80 | 3 | 25 | - | 125 |
| CEC302 | Mechanics of Solids | 20 | 20 | 20 | 80 | 3 | - | - | 100 |
| CEC303 | Engineering Geology | 20 | 20 | 20 | 80 | 3 | - | - | 100 |
| CEC304 | Architectural Planning & Design of Buildings | 20 | 20 | 20 | 80 | 3 | - | - | 100 |
| CEC305 | Fluid Mechanics- I | 20 | 20 | 20 | 80 | 3 | - | - | 100 |
| CEL301 | Mechanics of Solids | - | - | - | - | - | 25 | 25 | 50 |
| CEL302 | Engineering Geology | - | - | - | - | - | 25 | 25 | 50 |
| CEL303 | Architectural Planning & Design of Buildings | - | - | - | - | - | 25 | 25 | 50 |
| CEL304 | Fluid Mechanics- I | - | - | - | - | - | 25 | 25 | 50 |
| CEL305 | Skill Based Lab Course-I | - | - | - | - | - | 50 | - | 50 |
| CEM301 | Mini Project – 1 A | - | - | - | - | - | 25 | 25 | 50 |
| | **Total** | | | **100** | **400** | **-** | **200** | **125** | **825** |
| | | | | | | | | | |

# Semester – IV

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| CEC401 | Engineering Mathematics - IV | 3 | -- | 1 | 3 | - | 1 | 4 |
| CEC402 | Structural Analysis | 4 | -- | - | 4 | - | - | 4 |
| CEC403 | Surveying | 3 | -- | - | 3 | - | - | 3 |
| CEC404 | Building Materials &Concrete Technology | 3 | -- | - | 3 | - | - | 3 |
| CEC405 | Fluid Mechanics-II | 3 | - | - | 3 | - | - | 3 |
| CEL 401 | Structural Analysis | -- | 2 | - | - | 1 | - | 1 |
| CEL 402 | Surveying | -- | 3 | - | - | 1.5 | - | 1.5 |
| CEL 403 | Building Material Concrete Technology | -- | 2 | - | - | 1 | - | 1 |
| CEL 404 | Fluid Mechanics-II | -- | 2 | | | 1 | | 1 |
| CEL 405 | Skill Based lab Course-II | -- | 2 | - | - | 1 | - | 1 |
| CEM401 | Mini Project – 1 B | -- | 3[$] | - | - | 1.5 | - | 1.5 |
| **Total** | | **16** | **14** | **1** | **16** | **7** | **1** | **24** |

| **Examination Scheme** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **Internal Assessment** | | | **End Sem Exam** | **Exam Duration (Hrs.)-** | **Term Work** | **Prac. /Oral** | **Total** |
| | | Test I | Test II | Avg. | | | | | |
| CEC 401 | Engineering Mathematics - IV | 20 | 20 | 20 | 80 | 3 | 25 | - | 125 |
| CEC 402 | Structural Analysis | 20 | 20 | 20 | 80 | 3 | - | - | 100 |
| CEC 403 | Surveying | 20 | 20 | 20 | 80 | 3 | | | 100 |
| CEC 404 | Building Materials & Concrete Technology | 20 | 20 | 20 | 80 | 3 | - | - | 100 |
| CEC 405 | Fluid Mechanics-II | 20 | 20 | 20 | 80 | 3 | - | - | 100 |
| CEL 401 | Structural Analysis | | | | | | 25 | 25 | 50 |
| CEL 402 | Surveying | | | | | | 50 | 25 | 75 |
| CEL 403 | Building Materials & Concrete Technology | - | - | - | - | - | 25 | 25 | 50 |
| CEL 404 | Fluid Mechanics-II | - | - | - | - | - | 25 | 25 | 50 |
| CEL 405 | Skill Based lab Course-II | - | - | - | - | - | 50 | - | 50 |
| CEM401 | Mini Project – 1 B | - | - | - | - | - | 25 | 25 | 50 |
| | **Total** | | | **100** | **400** | **-** | **225** | **125** | **850** |

| Semester- III |
|---|

| Course Code | Course Name | Credits |
|---|---|---|
| CEC 301 | Engineering Mathematics-III | 04 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | 01 | 03 | - | 01 | 04 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem. Exam | Duration of End Sem. Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 hrs | 25 | - | - | 125 |

**Pre-requisite:** Engineering Mathematics-I,

Engineering Mathematics-II,

**Course Objectives:**

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills.
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

**Course Outcomes:** Learner will be able to….

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations.

| Module | Detailed Contents | Hrs. |
|---|---|---|
| 01 | **Module: Laplace Transform**<br>1.1 Definition of Laplace transform, Condition of Existence of Laplace transform,<br>1.2 Laplace Transform (L) of Standard Functions like $e^{at}$, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n$ , $where\ n \geq 0$.<br>1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof).<br>1.4 Evaluation of integrals by using Laplace Transformation.<br>**Self-learning topics:** Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function. | 07 Hrs. |
| 02 | **Module: Inverse Laplace Transform**<br>2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative<br>2.2 Partial fractions method & first shift property to find inverse Laplace transform.<br>2.3 Inverse Laplace transform using Convolution theorem (without proof)<br>**Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations. | 06 Hrs. |
| 03 | **Module: Fourier Series:**<br>3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof)<br>3.2 Fourier series of periodic function with period $2\pi$ and $2l$,<br>3.3 Fourier series of even and odd functions<br>3.4 Half range Sine and Cosine Series.<br>**Self-learning Topics:** Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform. | 07Hrs. |
| 04 | **Module: Complex Variables:**<br>4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z),<br>Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof),<br>4.2 Cauchy-Riemann equations in cartesian coordinates (without proof)<br>4.3 Milne-Thomson method to determine analytic function *f*(z) when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. | 07Hrs. |

| | | |
|---|---|---|
| | 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories<br><br>**Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations | |
| **05** | **Module: Matrices:**<br>5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (**No theorems/ proof**)<br>5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix.<br>5.3 Functions of square matrix<br>5.4 Similarity of matrices, Diagonalization of matrices<br><br>**Self-learning Topics:** Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction) | 06 Hrs. |
| **06** | **Module: Numerical methods for PDE**<br>6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems)<br>6.2 Crank Nicholson method<br>6.3 Bender Schmidt method<br>**Self-learning Topics:** Analytical methods of solving two and three dimensional problems. | 06 Hrs. |
| | **Total** | 39 |

## Term Work:

General Instructions:

1 Batch wise tutorials are to be conducted. The number of student'sperbatch should be as per University pattern for practicals.

2 Students must be encouraged to write at least 6 class tutorials on entire syllabus.

3 A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

| | | |
|---|---|---|
| 1 | Attendance (Theory and Tutorial) | 05 marks |
| 2 | Class Tutorials on entire syllabus | 10 marks |
| 3 | Mini project | 10 marks |

## Assessment:

**Internal Assessment for 20 marks:** Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

**End Semester Examination:** Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1 Question paper will comprise of total six questions, each carrying 20 marks
2 Question 1 will be compulsory and should cover maximum contents of the curriculum
3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4 Only Four questions need to be solved.

## References:


1 Engineering Mathematics, Dr. B. S. Grewal, KhannaPublication
2 Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited,
3 Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosapublication
4 Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5 Higher Engineering Mathematics B.V. Ramana, McGraw HillEducation
6 Complex Variables and Applications, Brown and Churchill, McGraw-Hilleducation,
7 Text book of Matrices, Shanti Narayan and P K Mittal, S. ChandPublication
8 Laplace transforms, Murray R. Spiegel, Schaum's OutlineSeries


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| Semester- III | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | | | **Course Name** | | | | | **Credits** | |
| **CEC 302** | | | **Mechanics of Solids** | | | | | **4** | |
| **Contact Hours** | | | | **Credits Assigned** | | | | | |
| **Theory** | **Practical** | **Tutorial** | | **Theory** | **Practical** | **Tutorial** | | **Total** | |
| **4** | **-** | | | **4** | **-** | **--** | | **4** | |
| **Theory** | | | | | **Term Work/Practical/Oral** | | | **Total** | |
| **Internal Assessment** | | | **End Sem. Exam** | **Duration of End Sem Exam** | **TE** | **PR** | **OR** | | |
| **Test-I** | **Test-II** | **Average** | | | | | | | |
| **20** | **20** | **20** | **80** | **3 Hours** | **-** | **--** | **--** | **100** | |

## Rationale

Civil Engineering structures are made using various engineering materials such as steel, concrete, timber, other metals or their composites. They are subjected to force systems resulting into axial forces, bending moments, shear forces, torsion and their combinations. Different materials respond differently to these by getting deformed and having induced stresses. Determination of stress, strain, and deflection suffered by structural elements when subjected to diverse loads is prerequisite for an economical and safe design.

In this course, learners will understand the internal response behavior of material under different force systems. The knowledge of 'Mechanics of Solids' will be foundation of essential theoretical background for the subjects of Structural Analysis and Structural Design.

## Objectives

1) To learn stress - strain behavior and physical properties of materials and to compute the Stresses developed and deformation of Elastic members and thin cylinders subjected to internal pressure.
2) To learn to represent graphically the distribution of axial force, shear force and bending moment along the length of statically determinate beams and portal frames.
3) To compute area moment of inertia and to analyze the distribution of shear stress and the flexural (bending) stress across the cross section of structural members.
4) To study circular shafts under the action of twisting moment and to determine the direct and bending stresses in columns and study buckling behavior of centrally and eccentrically loaded columns.
5) To determine principal planes and stresses and strain energy computation in elastic members.
6) To learn the computation of slope and deflection of elastic beams and general theorems used in this computation.

| Detailed Syllabus | | | |
|---|---|---|---|
| **Module** | | **Course Modules / Contents** | **Periods** |
| **1** | **Module Name- Stresses and Strains in Elastic members, Spherical and Cylindrical shells** | | **(9)** |
| | **1.1** | Types of Stresses and Strains, stress-strain curve, different types of Elastic moduli and relationships between them, Poisson's ratio, factor of safety. Bars of varying sections, composite sections, temperature stresses | **6** |
| | **1.2** | Thin cylindrical and spherical shells under Internal pressure: Determination of Hoop stress, Longitudinal stress, Shear stress and volumetric strain. | **3** |
| **2** | **Module Name- Axial force, shear force and bending moment diagrams for beams and portal frames** | | **(9)** |
| | **2.1** | Concept of Axial Force, Shear Force and Bending Moment.<br>a) A.F. S.F. and B M Diagrams for statically determinate S S and Cantilever **beams without internal hinges** and for single loading like point load, UDL, UVL or Couple moment.<br>b) A.F. S.F. and B.M. Diagrams for statically determinate **beams with internal hinges** and combination of loading | **6** |
| | **2.2** | A.F. S.F. and B.M Diagrams for statically determinate **3-member Portal Frames with or without internal hinges .** | **3** |
| **3** | **Module Name- Area Moment of Inertia, Shear stresses and Bending stresses in beams** | | **(9)** |
| | **3.1** | Area Moment of inertia, Parallel and Perpendicular axis theorem, polar moment of inertia. Radius of gyration. (Rectangular, Triangular, Circular, Semicircular section and their combination)<br>Distribution of shear stress across plane sections Commonly used for structural purposes. | **5** |
| | **3.2** | Theory of pure bending, Flexure formula for straight beam, simple problems involving application of Flexure formula, section modulus, moment of resistance, flitch beams. | **4** |
| **4** | **Module Name- Torsion in Shafts, Columns** | | **(10)** |
| | **4.1** | Torsion in solid and hollow circular shafts, shafts with varying cross sections, Shafts transmitting and receiving power at different points. Stresses in Shafts while transmitting power. | **4** |
| | **4.2** | Direct and bending stresses in Columns, Core of section. | **6** |

| | | | |
|---|---|---|---|
| | | Buckling of Columns, Members subjected to axial loading, concept of buckling, effective length, different support conditions, Euler's and Rankine's formula. Concept of Eccentrically loaded columns. | |
| **5** | **Module Name- Principal planes and stresses, Strain Energy** | | **(8)** |
| | **5.1** | General equation for transformation of stress, Principal planes and principal stresses, maximum Shear stress, stress determination by analytical and Graphical method (using Mohr's circle). | **4** |
| | **5.2** | Strain energy due to axial force and impact loads in columns, due to bending in beams, due to torsion of shaft. | **4** |
| **6** | **Module Name- Slope and Deflection in Beams , General Theorems** | | **(7)** |
| | **6.1** | Concept of Slope and Deflection in Beams, Macaulay's Method for slope and deflection in S S and Cantilever beams subjected to point loads, UDL and couple moments. | **4** |
| | **6.2** | General Theorems: Betti and Maxwell's reciprocal Theorem,, Principle of Superposition, Principle of Virtual work, Castigliano's theorems. | **3** |

## Contribution to Outcome

On completion of this course, the students will be able to:

1) Evaluate stress - strain behavior of elastic members and thin cylinders subjected to internal pressure.
2) Draw variation of axial force, shear force and bending moment diagram for statically determinate beams and frames.
3) Calculate Moment of Inertia for cross sections and analyse the material response under the action of shear and the effect of flexure (bending).
4) Predict the angle of twist and shear stress developed in torsion and compute direct and bending stresses developed in the cross section of centrally and eccentrically loaded columns.
5) Locate principal planes in members and calculate principal stresses using analytical and graphical method and to calculate strain energy stored in members due to elastic deformation.
6) Evaluate slope and deflection of beams supported and loaded in different ways.

**Internal Assessment (20 Marks):**

One **Compulsory Class Test,** based on approximately 40% of contents and another on 40% from the remaining content be taken. Average of the two will be considered as IA Marks.

**End Semester Examination (80 Marks):**

Weightage of each module in end semester examination will be proportional to number of respective lecture

Hours mentioned in the curriculum.

1) Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2) **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3) **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4) Only **Four questions need to be solved**.

**Recommended Books:**


1. Strength of Materials: *S. Ramamrutham*, Dhanpatrai Publishers.
2. Strength of Materials: *R.K. Rajput*, S. Chand Publications.
3. Mechanics of Materials: Vol-I: *S.B. Junnarkar and H.J. Shah*, Charotar Publications.
4. Strength of Materials: *Subramanian*, Oxford University Press
5. Strength of Materials: *S.S. Rattan*, Tata Mc-Graw Hill, New Delhi
6. Strength of Materials (Mechanics of Materials): *R.S. Lehri and A.S. Lehri*, S.K. Kataria Publishers, New Delhi
7. Strength of Materials: *Dr. V.L. Shah*, Structures Publications, Pune


**Reference Books:**


8. Mechanics of Materials: *James, M. and Barry J.*; Cengage Learning.
9. Mechanics of Materials: *Andrew Pytel and Jaan Kiusalaas*, Cengage Learning.
10. Mechanics of Materials: *Timoshenko and Gere*, Tata McGraw Hill, New Delhi.
11. Mechanics of Materials: *James M. Gere*, Books/Cole.
12. Strength of Materials: *G.H. Ryder*, Mc-Millan.
13. Mechanics of Materials: *E.P. Popov*, Prentice Hall India (PHI) Pvt. Ltd.
14. Mechanics of Materials: *Pytel and Singer*, Mc-Graw Hill, New Delhi.
15. Strength of Materials: *William A. Nash and Nillanjan Mallick*, Mc-Graw Hill Book Co. (Schaum's Outline Series)


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## Semester-III

| Course Code | Course Name | Credits |
|---|---|---|
| CEC 303 | Engineering Geology | 3 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 3 | | - | 3 | | - | 3 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 3 hrs | | - | | 100 |

## Rationale

Engineering geology is an applied geology discipline that involves the collection, analysis, and Interpretation of geological data and information required for the safe development of civil works. The objective of this course is to focus on the core activities of engineering geologists – site characterization, geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock in the characterization of geologic sites for civil work projects.

Understanding of the foundation rocks and structures present in them is of utmost importance for the safety and stability of Civil engineering structures. The study also helps in the assessment of groundwater, oil and gas and mineral resource evaluation.

## Objectives

1. To acquire basic knowledge of Geology and to understand its significance in various civil engineering projects.
2. To study minerals and rocks in order to understand their fundamental characteristics and engineering properties.
3. To study structural geology for characterization of site, analysis and report geologic data using standards in engineering practice.
4. To study methods of subsurface investigation, advantages and disadvantages caused due to geological conditions and assessment of site for the construction of civil structures.
5. To study rock mass characterization for the construction of tunnels and assessment of rock as source of ground water.
6. To study the control of geology over the natural hazards and their preventive measures.

## Detailed Syllabus

| Module | | Course Modules / Contents | Periods |
|---|---|---|---|
| 1 | **Introduction & Physical Geology** | | **5** |
| | **1.1** | Branches of geology useful to civil engineering, Importance of geological studies in various civil engineering Projects. Departments dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. | |
| | **1.2** | Internal structure of the Earth and use of seismic waves in understanding the interior of the earth. Theory of Plate Tectonics. | |
| | **1.3** | Weathering types, Erosion and Denudation. Factors affecting weathering and product of weathering (engineering consideration) Superficial deposits and its geological Importance. | |
| | **1.4** | Brief study of geological action of wind, glacier and river. | |
| 2 | **Mineralogy and Petrology** | | **7** |
| | **2.1** | Identification of minerals with the help of physical properties, rock forming minerals, megascopic identification of primary and secondary minerals, study of common ore minerals. | |
| | **2.2** | Igneous Petrology - Mode of formation, Texture and structure, form of Igneous rocks, Classification of Igneous rocks, study of commonly occurring igneous rocks, Engineering aspect of Granite and Basalt. | |
| | **2.3** | Sedimentary Petrology - Mode of formation, Textures, characteristics of shallow water deposits like lamination, bedding, current bedding etc., classification, study of commonly occurring sedimentary rocks and their engineering application. | |
| | **2.4** | Metamorphic Petrology - Mode of formation, agents and types of metamorphism, structures and textures of metamorphic rocks, classification and study of commonly occurring metamorphic rocks and their engineering application. | |
| 3 | **Structural Geology and Stratigraphy** | | **12** |
| | **3.1** | Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Type of discontinuities in the rocks.<br><br>**Fold:** Terminology, Classification on the basis of position of axial plane, Criteria for their recognition in field and engineering consideration.<br><br>**Fault:** Terminology, Classification on the basis of movement of faulted block, Criteria for recognition in field, effects on outcrops and Engineering consideration. | |

| | | | |
|---|---|---|---|
| | | **Joints & Unconformity:** Types and geological importance.<br>Three point problems to determine attitude of the strata | |
| | **3.2** | Determination of thickness of the strata with the help of given data. | |
| | **3.3** | Geological Maps and their application for civil engineering works, Identification of symbols in maps. | |
| | **3.4** | General principles of Stratigraphy, geological time scale, Physiographic divisions of India and their characteristics. Stratigraphy of Deccan Volcanic Province. | |
| **4** | **Geological Investigation, study of dam and reservoir site:** | | **7** |
| | **4.1** | Required geological consideration for selecting dam and reservoir site. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions. | |
| | **4.2** | Electrical resistivity and Seismic method of geological investigation. Rock Quality Designation and its importance to achieve safety and economy of the projects like dams and tunnels. | |
| | **4.3** | Borehole problems and their significance in determining subsurface geology of the area. | |
| **5** | **Tunnel Investigation and Ground Water Control** | | **5** |
| | **5.1** | Importance of geological considerations while choosing tunnel sites and alignments of the tunnel, safe and unsafe geological and structural conditions. | |
| | **5.2** | Geo-mechanics classification (RMR) and its application. | |
| | **5.3** | Sources, zones, water table, unconfined, confined and Perched water tables. Factors controlling water bearing capacity of rocks, Pervious and Impervious rocks, Different types of rocks as source of ground water. Artesian well (flowing and non-flowing). Cone of Depression and its use in Civil engineering. | |
| **6** | **Geological Disasters and Control Measures** | | **3** |
| | **6.1** | Landslides-Types, causes and preventive measures for landslides, Landslides in Deccan region. | |
| | **6.2** | Volcano- Central type and fissure type, products of volcano. | |
| | **6.3** | Earthquake- Terminology, Earthquake waves, construction and working of seismograph, Earthquake zones of India, elastic rebound theory, Preventive measures for structures constructed in Earthquake prone area. | |

**Contribution to Outcome**

On completion of this course, the students will be able to:

1) Explain the concepts of Geology and its application for safe, stable and economic design of any civil engineering structure.
2) Interpret the lithological characters of the rock specimen and distinguish them on the basis of studied parameters.
3) Describe the structural elements of the rocks and implement the knowledge for collection and analysis of the geological data.
4) Interpret the geological conditions for the dam site and calculate RQD for the assessment of rock masses.
5) Analyze the given data and suggest rock mass rating for assessment of tunnelling conditions.
6) Interpret the causes of geological hazards and implement the knowledge for their prevention.

**Internal Assessment (20 Marks):**

Consisting **Two Compulsory Class Tests** - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination (80 Marks):**

Weightage of each module in end semester examination will be proportional to number of respective lecturehours mentioned in the curriculum.

1) Question paper will comprise of total **six questions**, **each carrying 20 marks.**
2) **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3) **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4) Only **Four questions need to be solved**.

**Recommended Books:**


1) Text book of Engineering Geology: N. Chenna, Kesavulu, Mc-Millan.
2) Text book of Engineering and General Geology, 8th edition (2010): Parbin Singh, S K Kataria& Sons.
3) Text book of Engineering Geology: P. K. Mukerjee, Asia.
4) Text book of Engineering Geology: Dr. R. B. Gupte, Pune VidyarthiGriha
5) Prakashan, Pune.
6) Principles of Engineering Geology: K. M. Banger.


**Reference Books:**


7) A Principles of Physical Geology: Arthur Homes, Thomas Nelson Publications, London.
8) Structural Geology, 3rd edition (2010): Marland P. Billings, PHI Learning Pvt. Ltd. New Delhi
9) Earth Revealed, Physical Geology: David McGeeary and Charles C. Plummer
10) Principles of Geomorphology: William D. Thornbury, John Wiley Publications, New York.
11) Geology for Civil Engineering: A. C. McLean, C.D. Gribble, George Allen &UnwinLondon.
12) Engineering Geology: A Parthsarathy, V. Panchapakesan, R Nagarajan, Wiley India 2013.


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## Semester - III

| Course Code | Course Name | Credits |
|---|---|---|
| CEC304 | Architectural Planning & Design of Buildings | 02 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 02 | - | - | 02 | - | - | 02 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 Hrs | --- | - | | 100 |

## Rationale

Drawing is the language of Civil Engineers to communicate. Drawing is one of the most essential documents as far as civil engineering is concerned. It provides guidance and instructions to architects, engineers and workmen at field, on how to construct structures according to the figures and dimensions shown in the drawing. Approved drawings are also essential for the estimation of cost and materials; as well as a very important contract document.

## Objectives

1) To remember and recall the intricate details of building design and drawing.
2) To gain an understanding of the basic concepts of building design and drawing.
3) To learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices, rules, regulation and byelaws, Building codes
4) To identify, analyze, research literate and solve complex building design and drawing problems.
5) To have new solutions for complex building design and drawing problems.
6) To effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

## Course Outcomes

At the end of the course learners will be able to:

1) Remember and recall the intricate details of building design and drawing.
2) Understand the basic concepts of building design and drawing.
3) Learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices.
4) Identify, analyze, research literate and solve complex building design and drawing problems.
5) Have new solutions for complex building design and drawing problems.
6) Effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

| Detailed Syllabus | | |
|---|---|---|
| **Module** | **Sub- Modules/ Contents** | **Periods** |
| **1** | **Principles and Codes of Practices for Planning and Designing of Buildings(Residential and Public buildings)** | **8** |
| 1.1 | Study of IS 962: 1989 – Code of Practice for Architectural and Building Drawings; How to develop Line plan into actual PLAN, ELEVATION, Section etc. including all the constructional details of various components in a BUILDING | |
| 1.2 | Principles of planning for Residential buildings | |
| 1.3 | Classification of buildings: Residential –Individual Bungalows & Apartments/Flats.<br>Public – Education (Schools, Colleges etc.) &Health (Primary Health Center, Hospital) related buildings | |
| 1.4 | Study & drawing of SITE PLAN,FOUNDATION PLAN,ROOF PLAN of building;<br>Study of building Bye – laws, Zoning Regulations and permissions required from commencement to completion of the building according to National Building Code (N.B.C.) of India and local Development Control (D.C.) rules | |
| 1.5 | Study of sun path diagram, wind rose diagram and sun shading devices | |
| 1.6 | Calculation of setback distances, carpet area, built-up area and floor spaceindex (FSI) | |
| 1.7 | Study of Principles of planning for public buildings:<br>i) Building for education: schools, colleges, institutions etc.<br>ii) Buildings for health: hospitals, primary health centers etc. | |
| **2.** | **Components and Services of a Building** | **3** |
| 2.1 | Staircase (dog -legged) planning, designing & drawing in details | |
| 2.2 | Foundations: stepped footing, isolated sloped footing and combined footing | |
| 2.3 | Openings: doors and windows | |
| 2.4 | Types of pitched roof and their suitability (plan and section) | |
| 2.5 | Building services: Water supply, sanitary and electrical layouts | |
| **3.** | **Perspective Drawings** | **4** |
| 3.1 | One-point perspective drawing | |
| 3.2 | Two-point perspective drawing | |
| **4** | **Town Planning, Architectural Planning & Built Environment** | **3** |
| 4.1 | Objectives and planning of TOWN PLANNING | |
| 4.2 | Master plan,<br>Re-Development of buildings, Slum rehabilitation. | |
| 4.3 | Architectural Planning: introduction and principles | |
| 4.4 | Built Environment: introduction and principles | |
| **5** | **Green Buildings** | **2** |
| 5.1 | Introduction, uses ,objectives of Green Buildings and overview | |
| 5.2 | Study of Certification methods such as LEED, TERI, GRIHA, IGBC. | |
| **6.** | **Computer Aided Drawing (CAD)** | **6** |
| 6.1 | Details and learning methods of CAD in Civil Engineering structures | |
| 6.2 | Study and demonstration of any one of the professional CAD software's | |
| | **Total** | **26** |

**Theory Examination:**

1) Only 4 questions (out of 6) need to be attempted.
2) Question no. 1 will be compulsory and based on the drawing work of any one building, may be residential or public building.. Some questions from the remaining may be on Theory portion.
3) 4. Any 3 out of the remaining 5 questions need to be attempted.
4) In question paper, weightage of each module maybe approximately proportional to the number of lecture hours assigned to it in the syllabus.

**Internal Assessment:**

There will be **Two** class tests (to be referred to as an '**Internal Assessment'**) to be conducted in the semester. The first internal assessment (IA-I) will be conducted in the mid of the semester based on the 50% of the syllabus. It will be of 20 marks. Similarly, the second internal assessment (IA-II) will be conducted at the end of the semester and it will be based on next 50% of the syllabus. It will be of 20 marks. Lastly, the average of the marks scored by the students in both the Internal Assessment will be considered. Duration of both the IA examination will be of one hour duration, respectively. Civil Engineering Drawing (including Architectural aspect) by *M. Chakraborti* (Monojit Chakraborti Publications, Kolkata)

**Recommended Books**

1) Planning and Designing Buildings by Y. S. Sane (Modern Publication House, Pune)
2) Building Drawing and Detailing by B.T.S. Prabhu, K.V. Paul and C. V. Vijayan (SPADES Publication, Calicut)
3) Building Planning by Gurucharan Singh (Standard Publishers & Distributors, New Delhi)

**References:**

**1)** IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
2) National Building Code of India – 2005 (NBC 2005)
3) Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (https://mmrda.maharashtra.gov.in)
4) Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (https://www.nmmc.gov.in/development-control-regulations)
5) Development Plan and Control Regulation KDMC, https://mmrda.maharashtra.gov.in

**Reference Codes:**

1) National Building Code of India, 2005
2) IS 779-1978 Specification for Water Meter
3) IS 909-1975 Specification for Fire Hydrant
4) IS 1172-1983 Code of Basic Requirement for Water Supply, Drainage & Sanitation
5) IS 1742-1983 Code of Practice for Building Drainage

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| Semester- III |
|---|

| Course Code | Course Name | Credits |
|---|---|---|
| CEC305 | Fluid Mechanics - I | 03 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| 03 | - | - | 03 | - | - | 03 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem. Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| 20 | 20 | 20 | 80 | 03 hrs | - | - | - | 100 |

## Rationale

The concept of fluid mechanics in civil engineering is essential to understand the processes and science offluids. The course deals with the basic concepts and principles in hydrostatics, hydro kinematics andhydrodynamics with their applications in fluid flow problems.

## Objectives

The students will be able to learn:

1. The properties of fluids, units and dimensions
2. Pressure measurement, manometry, Hydrostatic forces acting on different surfaces, Principle of buoyancy and stability of floating body
3. Kinematic and Dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations.
4. Importance of fluid flow and various velocity measuring and discharge measuring devices used in pipes and channels.
5. The basic difference between incompressible and compressible flow, Propagation of pressure waves and stagnation points.

## Detailed Syllabus

| Module | | Course Modules / Contents | Periods |
|---|---|---|---|
| 1 | **Properties of Fluids** | | 05 |
| | Mass density, weight density, specific gravity, specific volume, viscosity, compressibility and elasticity, surface tension, capillarity, vapour pressure, types of fluids, and introduction to real life applications. | | |
| 2 | **Fluid Statics** | | 11 |
| | **2.1** | **Pressure Measurement:** Pascal's law, hydrostatic law, pressure variation in fluids at rest. Pressure scale, Absolute, atmospheric, gauge pressure, measurement of pressure using manometers | |
| | **2.2** | **Hydrostatic force on surfaces:** | |

| | | | |
|---|---|---|---|
| | | Total pressure and centre of pressure, total pressure on horizontal planesurface, vertical plane surface, Inclined plane surface, centre of pressure for vertical plane surface and for inclined plane surface, practical applications of total pressure and centre of pressure on dams, gates, and tanks. | |
| | **2.3** | **Buoyancy and floatation:**<br>Archimedes principle, Meta-Centre, metacentric height, Stability of floating and submerged bodies, determination of metacentric height, Experimental and analytical methods, metacentric height for floating bodies containing liquid, Time period of Transverse oscillations of floating bodies. | |
| **3** | **Fluid Kinematics** | | **05** |
| | Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and acceleration of fluid particles, streamline, streak line, path line,velocity potential and stream function, equipotential lines and flow net, uses of flow net, rotational and irrotational motions, circulation and vorticity | | |
| **4** | **Fluid Dynamics** | | **06** |
| | Control volume and control surface, Forces acting on fluid in motion, Navier Stokes Equation, Euler's Equation of motion, Integration of Euler's equations of motion, Bernoulli's Theorem and its derivation, Bernoulli's equation for compressible fluid and real fluid, practical applications of Bernoulli's Equation - Venturimeter, Orifice meter, nozzle meter, pitot tube, Rota meter. | | |
| **5** | **Flow measurement** | | **08** |
| | **5.1** | **Orifices and mouthpieces**<br>Classification of orifices, flow through orifices, determination of hydraulic coefficients, flow through large rectangular orifice, flow through fully submerged and partially submerged orifice, time of emptying a tank through an orifice at its bottom. Classification of Mouthpieces, Flow through external cylindrical mouthpiece, convergent-divergent mouthpiece, Borda's mouthpieces. | |
| | **5.2** | **Notches and weirs**<br>Classification of notches and weirs, discharge over a rectangular, triangular, trapezoidal notch/weir, velocity of approach, stepped notch, Cipolleti weir, broad crested weir, ogee weir, discharge over a submerged weir, ventilation of weirs. | |
| **6** | **6.1** | **Compressible flow** | **04** |
| | | Basic equation of flow (elementary study), velocity of sound or pressure wave in a fluid, Mach number, propagation of pressure waves, area-velocity relationship, Stagnation properties. | |
| **Total** | | | **39** |

**Contribution to Outcome**

Upon completion of the course, students shall have ability to:

1) Describe various properties of fluids and types of flow
2) Determine the pressure difference in pipe flows, application of Continuity equation and Bernoulli's theorem to determine velocity and discharge
3) Apply hydrostatic and dynamic solutions for fluid flow applications
4) Analyse the stability of floating bodies
5) Apply the working concepts of various devices to measure the flow through pipes and channels
6) Explain the compressible flow, propagation of pressure waves and stagnation properties

**Internal Assessment (20 Marks):**

**Consisting Two Compulsory Class Tests:**

First test based on approximately 40% of contents and second test based on remainingcontents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination (80 Marks):**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1) Question paper will comprise of total **six questions, each carrying 20 marks.**
2) **Question 1**will be compulsory and should **cover maximum contents of the curriculum**
3) **Remaining questions will be mixed in nature**(for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4) Only **Four questions need to be solved**.

**Recommended Books:**


1) Hydraulics and Fluid mechanics: Dr. P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
2) Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
3) Fluid Mechanics: Dr. A.K Jain, Khanna Publishers.
4) Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt.Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
5) Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
6) Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.


**Reference Books:**


1) Fluid Mechanics: Frank M. White, Tata McGraw Hill International Edition.
2) Fluid Mechanics: Streeter White Bedford, Tata McGraw International Edition.
3) Fluid Mechanics with Engineering Applications: R.L. Daugherty, J.B. Franzini, E.J. Fennimore, Tata McGraw Hill, New Delhi.
4) Hydraulics: James F. Cruise, Vijay P. Singh and Mohsen M. Sherif, CENGAGE Learning India (Pvt.) Ltd.
5) Introduction to Fluid Mechanics: Edward J. Shaughnessy, Jr, Ira M. Katz, James P. Schaffer. Oxford Higher Education.

**Semester- III**

| Course Code | Course Name | Credits |
|---|---|---|
| CEL301 | Mechanics of Solids- LAB | 01 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 02 | - | - | 01 | - | 01 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| - | - | - | - | - | 25 | - | 25 | 50 |

## Objectives

1) To learn stress - strain behavior and physical properties of materials and to compute the Stresses developed and deformation of Elastic members.
2) To compute the distribution of shear stress and the flexural (bending) stress across the cross section of structural members
3) To study circular shafts under the action of twisting moment.
4) To learn the computation of slope and deflection of elastic beams and general theorems used in this computation.

## Outcomes

Learner will be able to…

1) Evaluate stress - strain behavior of materials and assess the structural behavior by the virtue of stresses developed and deformation of elastic members.
2) Analyze the material response under the action of shear and the effect of flexure (bending).
3) Predict the angle of twist and shear stress developed in torsion.
4) Evaluate slope and deflection of beams supported and loaded in different ways.

**Term Work :**Term work comprises of Laboratory work and assignments.

**Laboratory work : (At least 6- Performances - Any one from each Module)**

| **Mechanics of Solids (Practical performance)** | | |
|---|---|---|
| **Schedule** | **Name of Experiment** | **Duration (Hours)** |
| **1st week** | 1) Using UTM find different Moduli of a material or<br>2) The Tension Test on M S rod or<br>3) The Tension Test on M S Flat | **2** |
| **3rd week** | 1) The Compression Test on Concrete cube or<br>2) The Compression Test on Timber or<br>3) The Compression Test on Brick | **2** |
| **5th week** | 1) Test of Bending Using a Strain Guage or<br>2) Test of Bending Using a other electronic devices or<br>3) Test of Shear Stress in Beams | **2** |
| **7th week** | 1) Using TorsionTesting Machine, verify the torsion equation, find different Moduli of a material. or<br>2) Spring Stiffness Test using strain gauges or other electronic devices | **2** |
| **9th week** | 1) Charpy impact testing and Energy concept. or<br>2) Izod impact testing and Energy concept. | **2** |
| **11th week** | 1) Using U T M perform experiments and verify Slope and deflection equations, 3 points and 4 points loading. (Performance) or<br>2) Deflection of Simply supported Beams (Performance) or<br>3) Deflection of Cantilever Beams (Performance) | **2** |
| Total Duration = 12 Hours | | |

**Assignment:**

**(**At least 1 from each module as per the Course instructor's guidelines; it is to be assessed during Laboratory hours. In order to avoid Copying/ repetition, Course Instructor may give different assignments to different groups.)

| **Mechanics of Solids** | | |
|---|---|---|
| **Schedule** | **Assignment** | **Duration (Hours)** |
| **2nd week** | **Stresses and strains in Elastic members, Spherical and Cylindrical shells**<br>• Prepare a model of Cylindrical vessel or<br>• Prepare a model of spherical vessel or<br>• Prepare a model of Cylindrical vessel with hemispherical ends or<br>• Prepare a chart showing diagrammatic representation of stresses or<br>• A set of 5 questions on a module designed by course instructor, or<br>• A site visit to a relevant place or<br>• A model / chart based on a module or<br>• Design of a new experiment based on a module or<br>• Write a Computer program in C++ or MSExcel on how to find a particular quantity from given data (Ex: Find output, Elongation 'δ' from the input values of P,L,A and E)<br>• A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document – Appendix I) | **2** |

| | | |
|---|---|---|
| **4th week** | **Axial force, shear force and bending moment diagrams for beams and portal frames**<br>• A set of 5 questions on a module designed by course instructor, or<br>• A site visit to a relevant place or<br>• A model / chart based on a module or<br>• Design of a new experiment based on a module or<br>• A chart about scientists and their contribution to the study of 'Mechanics of Structures' (Example given at the end of this document) or<br>• Prepare a chart showing AFD, SFD & BMD for different symmetric and asymmetric loads on S S beams or<br>• Prepare a chart showing AFD, SFD & BMD for different loads on Cantilever beams | **2** |
| **6th week** | **Area Moment of Inertia, Bending stresses and Shear stresses in beams**<br>• Prepare a chart showing MI @ XX, YY &ZZ axes passing through the centroid. or<br>• Prepare 3D models of different typical cross sections of beams and find their cross sectional area, Ixx, Iyy and Izz.. or<br>• Prepare charts showing typical cross sections and variation of Bending stresses and shear stresses across the cross section. or<br>• A set of 5 questions on a module designed by course instructor, or<br>• A site visit to a relevant place or<br>• A model / chart based on a module or<br>• Design of a new experiment based on a module or<br>• Write a Computer program in C++ or MS Excel on how to find a particular quantity from given data (Ex: Find output, Flexural stress 'f' from the input values of P,L,I and E)<br>• A chart about scientists and their contribution to the study of 'Mechanics of Structures' (Example given at the end of this document) | **2** |
| **8th week** | **Torsion of Shafts, Columns**<br>• Prepare 3D models of different solid and hollow circular cross sections of shafts and find their cross sectional area, Ixx, Iyy and Izz. or<br>• A set of 5 questions on a module designed by course instructor, or<br>• Write a Computer program in C++ or MS Excel on how to find a particular quantity from given data (Ex: Find output, Shear stress 'q' or angle 'Ɵ' from the input values of T,L,G and J)<br>• A site visit to a relevant place or<br>• A model / chart based on a module or<br>• Design of a new experiment based on a module or<br>• A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document) | **2** |
| **10th week** | **Principal planes and stresses, Strain Energy**<br>• Draw typical stress transformation cases of Mohr's circle using graph paper. or<br>• A set of 5 questions on a module designed by course instructor, or<br>• A site visit to a relevant place or<br>• A model / chart based on a module or<br>• Design of a new experiment based on a module or<br>• A chart about scientists and their contribution to the study of 'Mechanics of solids' (Example given at the end of this document) | **2** |

| | | |
|---|---|---|
| **12th week** | **Slope and Deflection in Beams ; General Theorems**<br>• Prepare chart to explain General theorems for slope and deflection. or<br>• A set of 5 questions on a module designed by course instructor, or<br>• A site visit to a relevant place or<br>• A model / chart based on a module or<br>• Design of a new experiment based on a module or<br>• A chart about scientists and their contribution to the study of 'Mechanics of Solids' (Example given at the end of this document) | **2** |
| Total Duration = 12 Hours | | |

**Appendix -I:**

A chart about scientists and their contribution to the study of 'Mechanics of solids' be made by students. Contributions of Scientists like GiordanoRiccati, Leonhard Euler, Saint Venant, Christian Otto Mohr, William J M Rankine, Carlo Castigliano, EnricoBetti, Robert Hooke, W. H. Macaulay, Augustin- Louis Cauchy, Simeon Poisson can be studied and presented.

**Important Websites:**

1) http://www.iitk.ac.in/mseold/mse_new/facilities/laboratories/Material Testing Lab / MSE313A.pdf
2) https://home.iitm.ac.in/kramesh/Strength of Materials Laboratory Manual.pdf
3) https://www.researchgate.net/publication/338139499_Me_8381-Strength_Of_Materials_Lab_Manual

**Assessment:**

**To be done in 13th week**

- **Term Work:**

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory work- : 15 Marks
Assignments- : 10 Marks

The sum will be multiplied by a factor of attendance between
0.5 (for poor attendance) to 1 (very good attendance).

- **End Semester Oral Examination**

Oral examination will be based on entire syllabus

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| Semester- III | | |
|---|---|---|
| **Course Code** | **Course Name** | **Credits** |
| **CEL302** | **Engineering Geology Lab. Practice** | **1** |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| **Theory** | **Practical** | **Tutorial** | **Theory** | **Practical** | **Tutorial** | **Total** |
| **-** | **2** | **-** | **-** | **1** | **-** | **1** |

| Theory | | | | | Term Work/Practical/Oral | | | |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | Total |
| Test-I | Test-II | Average | | | | | | |
| - | - | - | - | 3 hrs | 25 | - | 25 | 50 |

## Objectives

1. To acquire basic knowledge of Geological Lab practices and apply it for the safe development of Civil Engineering works.
2. To examine the mineral and rock sample and understand their fundamental properties for their evaluation as construction and foundation material.
3. To study the Geological maps and their sections in terms of selecting the sites for various civil engineering structures.
4. To study Borehole problems for determination of subsurface geology of the area.
5. To Study the drilling data and calculate RQD for assessment of rock masses for Civil Engineering purposes.

## Outcomes

Learner will be able to…

1. Identify various rock forming minerals on the basis of physical properties.
2. Explain the characteristics of Igneous, Sedimentary and Metamorphic rocks and assess their suitability as construction material and foundation rock.
3. Interpret the rock characteristics and comment on their suitability as water bearing horizons.
4. Interpret the geological map and assess the suitability of the site for Civil Engineering works.
5. Solve the borehole problems and interpret it in order to understand subsurface Geology of the area.
6. Calculate RQD and evaluate the rock masses for Civil Engineering Works.

**A) List of Experiments**

| Module | Detailed Contents | Lab Sessions/Hr |
|---|---|---|
| **1** | **Study of Physical Properties of Minerals:** Identification of common Rock forming minerals on the basis of physical Properties- **Silica Group:** Quartz and its varieties; Cryptocrystalline silica: Jasper and Agate; **Feldspar Group:** Orthoclase, Plagioclase; **Carbonate Group:** calcite; **Amphibole Group:** Asbestos, Actinolite and Hornblende; **Pyroxene Group:**Augite; **Mica Group:**Muscovite, Biotite and Talc; **Element Group:** Graphite. | **6** |
| **2** | Identification of Metallic minerals: Galena, Pyrite, Hematite, Magnetite. | **2** |
| **3** | **Identification of rocks:** **Igneous Rocks**-Granite and its varieties, Syenite, Diorite, Gabbro, Pegmatite. Porphyry, Dolerite, Rhyolite, Pumice, Trachyte, Basalt and its varieties, Volcanic Breccia, Volcanic Tuffs. | **4** |
| **4** | **Sedimentary Rocks-** Conglomerate, Breccia, Sandstone and its varieties, Shales, Limestones, Laterites. | **2** |
| **5** | **Metamorphic Rocks-** Schist and its varieties, Gneiss and its varieties, Slate, Marbles, Quartzite and Phyllite. | **2** |
| **6** | **Geological Maps:** a) Horizontal strata: Drawing the cross section and assessment of geological history of the area. b) Inclined Strata: Calculation of dip and strike in an inclined strata and assessment of geological history of the area. c) Assessment of the geological conditions for a proposed dam site in the given map. d) Assessment of the geological conditions for a proposed tunnel site in the given map. e) Assessment of the geological conditions for groundwater reserve in the given map. | **6** |
| **7** | Borehole problems to interpret subsurface geology | **2** |
| **8** | Calculation of RQD from the given data and assessment of rock quality. | **2** |

**B) Assessment:**

- **Term Work**

Including Laboratory Work and Assignments both, Distribution of marks for Term Work Shall beas follows:

Laboratory work- : 10 Marks
Assignments- : 10 Marks
Attendance : 05 Marks

- **End Semester Oral Examination**

Oral examination will be based on the entire syllabus.

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## Semester- III

| Course Code | Course Name | Credits |
|---|---|---|
| CEL 303 | Architectural Planning & Design of Buildings Lab | 01 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 02 | - | - | 01 | - | 01 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| - | - | - | - | - | 25 | - | 25 | 50 |

@ **For the course 'Building Design and Drawing, the oral examination shall be conducted in conjunction with the sketching examination.**

## Rationale

Drawing is the language of Civil Engineers to communicate. Drawing is one of the most essential documents as far as civil engineering is concerned. It provides guidance and instructions to architects, engineers and workmen at field, on how to construct structures according to the figures and dimensions shown in the drawing. Approved drawings are also essential for the estimation of cost and materials; as well as a very important contract document.

### Course Objectives

1) To remember and recall the intricate details of building design and drawing.
2) To gain an understanding of the basic concepts of building design and drawing.
3) To learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices.
4) To identify, analyze, research literate and solve complex building design and drawing problems.
5) To have new solutions for complex building design and drawing problems.
6) To effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

### Course Outcomes:

At the end of the course, learners will be able to:

1) Plan and design of residential and public building by implementing the principles of planning of buildings, Green building principles, byelaws, regulations and codes for planning

2) Preparing various working and detailed drawing of the buildings in CAD.
3) Preparing layouts of various building services.
4) Preparing perspective views for all types of buildings
5) Preparing the reports based on the drawings prepared, if required

**Practical:**

Students should make all the drawings during the Practical time allotted to them.

1) Drawings (Manually) should be drawn in the allotted Drawing hall only.
2) Drawings (CAD sheets) should be drawn on the Desktop/Laptop in Computational Lab.

After completing the work, Print out of those sheets should be submitted for gradation/Marks.

**Assignments:**

Two Assignments should be completed, covering all the modules in the syllabus.

1) Assignment-1 should be on 50% of the syllabus, to be completed before Internal Assessment-I exam.
2) Assignment-2 should be on the remaining 50% of the Syllabus, to be completed before Internal Assessment-II exam.

**Site Visit**:

Students should visit any Residential building/Public building physically and take Measurements inside of all rooms & over all outside of the building & can submit asmalldrawing sheet with the help of CAD. (**Optional** only)

**Practical Examination (Oraland Sketching)**

Practical examination will consist of sketching and oral examination based on the entire syllabus.

**Term Work:**

**Drawings & Assignments:**

1) Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, Site plan, Foundation Plan and details of one FOOTING, Roof Plan ,schedule of opening and construction notes of a **residential building(bungalow or apartment)** to be constructed as a (G+1) R.C.C. framed structure **( only Manual Drawing)**
2) **One-Point** Perspective drawingfor any Residential structure( **only Manual drawing)**
3) Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, schedule of opening and construction notes of a **public building(**Education/Health related **)** be constructed as a (G+1) R.C.C. framed structure ( **only CAD drawing Sheet**)
4) **Two-Point** perspective drawing for any one public building (**only CAD drawing Sheet**)
5) Assignment No.- 1
6) Assignment No.- 2

**Distribution of Term-work Marks:**

The marks of term-work shall be judiciously awarded depending upon the quality of the term work. The final certification acceptance of term-work warrants the satisfactorily the appropriate completion of the required quality & quantity of work for the minimum passing marks to be obtained by the students. Broadly, the split of the marks for term work shall be as given below. However, there can be further bifurcation in the marks under any of the heads to account for any sub-head therein.

| | **Particulars** | **Marks** |
|---|---|---|
| 1 | Drawing Sheet (Manual) | **7.5** Marks |
| 2 | Drawing Sheet (CAD Based) | **7.5** Marks |
| 3 | Assignments | **5** Marks |
| 4 | Attendance | **5** Marks |
| | **Total** | **25 Marks** |

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to. 75% 80%: 03 Marks; 81% 90%: 04 Marks 91% onwards: 05 Marks **(Consider Practical attendance)**

**Recommended Books:**

- Building Drawing with an Integrated Approach to Built Environment by *M. G. Shah, C. M. Kale, S.Y. Patki*(Tata McGraw-Hill Education)
- Civil Engineering Drawing (including Architectural aspect) by *M. Chakraborti* (MonojitChakraborti Publications, Kolkata)
- Planning and Designing Buildings by *Y. S. Sane* (Modern Publication House, Pune)
- Building Drawing and Detailing by *B.T.S. Prabhu, K.V. Paul and C. V. Vijayan* (SPADES Publication, Calicut)
- Building Planning by *Gurucharan Singh* (Standard Publishers & Distributors, New Delhi)

**References:**

- IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
- National Building Code of India – 2005 (NBC 2005)
- Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (https://mmrda.maharashtra.gov.in)
- Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (https://www.nmmc.gov.in/development-control-regulations)
- Development Plan and Control Regulation KDMC, https://mmrda.maharashtra.gov.in

**Reference Codes:**

- National Building Code of India, 2005
- IS 779-1978Specification for water meter
- IS 909-1975 Specification for fire hydrant
- IS 1172-1983 Code of basic requirement for water supply ,drainage & sanitation
- IS 1742-1983 code of practice for building drainage

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**Semester- III**

| Course Code | Course Name | Credits |
|---|---|---|
| CEL304 | Fluid Mechanics – I (Lab) | 01 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 02 | - | - | 01 | - | 01 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| - | - | - | - | - | 25 | - | 25 | 50 |

**Course Objectives:**

The students will be able to learn:

1. The basic fluid mechanics concepts
2. Measuring pressure, velocity and discharge of fluid flow through pipes and channels

**Course Outcomes:**

At the end of the course, learner will be able to:

1. Calculate the metacentric height
2. Verify the Bernoulli's theorem
3. Determine the discharge coefficients
4. Measure fluid flow using various devices
5. Determine the hydraulic coefficients of an orifice

**List of Experiments (Minimum Six)**

| Module | Detailed Contents | Lab Sessions/Hr |
|---|---|---|
| 1 | Determination of the Metacentric height of a floating body | 02 hrs |
| 2 | Investigating the validity of the Bernoulli equation applied to a steady flow of water through a tapered duct | 04 hrs |
| 3 | Determination of coefficient of discharge of Venturimeter. | 02 hrs |
| 4 | Determination of coefficient of discharge of Orifice meter. | 02 hrs |
| 5 | Determination of coefficient of discharge of Nozzle meter. | 04 hrs |
| 6 | Determination of coefficient of discharge of Notches (Rectangular and Triangular notch). | 02 hrs |
| 7 | Determination of coefficient of discharge of weirs (Broad Crested weir and Ogee weir). | 04 hrs |
| 8 | To determine the value of coefficient of contraction, coefficient of velocity and coefficient of discharge for the given orifice | 04 hrs |
| 9 | Determination of coefficient of discharge of mouthpiece. | 02 hrs |

**Assessment:**

**Term Work**

Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

| | | |
|---|---|---|
| Laboratory work | : | 15 Marks |
| Assignments | : | 05 Marks |
| Attendance | : | 05 Marks |

**End Semester Oral Examination**

Oral examination will be based on entire syllabus.

**Reference Books:**


- Fluid Mechanics and Hydraulic Machines: R. K. Rajput, S. Chand and Company
- Hydraulics and Fluid mechanics: Dr.P.M. Modi and Dr. S.M. Seth, Standard Book House, Delhi
- Hydraulics Fluid Mechanics and Fluid Machines: S. Ramamrutham, DhanpatRai Publishing Company (P) Ltd-New Delhi
- Theory and Application of Fluid Mechanics: K. Subramanian, Tata McGraw hill publishing company, New Delhi.
- Fluid Mechanics and Hydraulics: Dr. S.K. Ukarande, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
- Fluid Mechanics and fluid pressure engineering: Dr. D.S. Kumar, F.K. Kataria and sons
- Fluid Mechanics: R.K. Bansal Laxmi Publications (P) Ltd.


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| Semester-III |
|---|

| Course Code | Course Name | Credits |
|---|---|---|
| CEL305 | Skill Based Lab Course-I<br>Computer Aided Drafting & Building Information Modelling | 1.5 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 3 | - | - | 1.5 | - | 1.5 |

| Theory | | | | | Term Work /Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem Exam | Duration of End Sem Exam | TW | PR | OR | |
| Test-I | Test-II | Average | | | | | | |
| - | - | - | - | - | 50 | - | - | 50 |

**Objectives:**

1. To enable the learners efficiently draft and label buildings components using the concepts of 2D and 3D drawing and detailing
2. To introduce the concepts of object-based modelling in 3-D environment to learners
3. To enable the learners to work on drawing and drafting softwares so that they can conveniently understand and design civil engineering components through the softwares.

**Outcomes:** Learner will be able to…

1. Transfer the plan from a drawing sheet to a 2-D drafting software
2. Visualize the various elements in the software like points, lines, polygons, etc. as objects of the real world and relate it with civil engineering components.
3. Apply civil engineering concepts to draft efficient civil engineering plans in accordance to various building bye laws and forms.
4. Conceptualize the space, logistic and statutory constraints in the real world to draw an efficient plan so that optimization is achieved
5. Attach and retrieve information pertaining to various civil engineering components through 3-D modelling software
6. Demonstrate a virtual walkthrough of buildings

C) **List of Experiments (Minimum Eight)**

| Module | Detailed Contents | Lab Sessions/Hr |
|---|---|---|
| 1 | Listing out the various Computer Aided Drawing and Drafting (CADD) tools available for civil engineering projects in the market and highlighting the capabilities and advantages of each | 03 |
| 2 | Basic introduction to compatibilities, utilities and attributes of peculiar drafting softwares w.r.t their various commands, features, capabilities and functions. | 03 |
| 3 | Line plan of a residential structure using a CADD tool | 03 |

| | | |
|---|---|---|
| 4 | Developed plan of a residential structure (minimum G+4) using a CADD tool | 06 |
| 5 | Developed plan of a public building using a CADD tool | 06 |
| 6 | Basic introduction to compatibilities, utilities and attributes of peculiar building information modelling (BIM) softwares w.r.t their various commands, features, capabilities and functions. | 03 |
| 7 | Creating families and basic models on BIM | 06 |
| 8 | Creating architectural plan on BIM of a G+1 bungalow | 03 |
| 9 | Demonstrating a walkthrough on BIM for clients and presenting it | 03 |
| 10 | Clash detection and removal | 03 |

**D) Assessment:**

- **Term Work**

Including Laboratory Work comprising of minimum 6 software generated sheets and one walkthrough presentation on BIM, distribution of marks for Term Work shall be as follows:

Laboratory work : 30 Marks (comprising of minimum 6 software generated sheets)

Presentation : 10 Marks (showing 3-D walk through the building)

Attendance : 10 Marks

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| Semester- III |
|---|

| Course Code | Course Name | Credits |
|---|---|---|
| CEM 301 | Mini Project -1 A | 1.5 |

| Contact Hours | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| - | 03 | - | - | 1.5 | - | 1.5 |

| Theory | | | | | Term Work/Practical/Oral | | | Total |
|---|---|---|---|---|---|---|---|---|
| Internal Assessment | | | End Sem. Exam | Duration of End Sem. Exam | TW | PR | OR | |
| Test- I | Test- II | Average | | | | | | |
| - | - | - | - | - | 25 | - | 25 | 50 |

## Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

## Outcome: Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

## Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.

- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

## Guidelines for Assessment of Mini Project:

## Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;

- Marks awarded by guide/supervisor based on log book : 10
- Marks awarded by review committee : 10
- Quality of Project report : 05

**Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.**

## One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
- First shall be for finalisation of problem
- Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
- First review is based on readiness of building working prototype to be conducted.
- Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

## Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

## Assessment criteria of Mini Project.

**Mini Project** shall be assessed based on following criteria;

1) Quality of survey/ need identification
2) Clarity of Problem definition based on need.
3) Innovativeness in solutions
4) Feasibility of proposed problem solutions and selection of best solution
5) Cost effectiveness
6) Societal impact
7) Innovativeness
8) Cost effectiveness and Societal impact
9) Full functioning of working model as per stated requirements
10) Effective use of skill sets
11) Effective use of standard engineering norms
12) Contribution of an individual's as member or leader
13) Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

## Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

**Mini Project** shall be assessed based on following points;

1) Quality of problem and Clarity
2) Innovativeness in solutions
3) Cost effectiveness and Societal impact
4) Full functioning of working model as per stated requirements
5) Effective use of skill sets
6) Effective use of standard engineering norms
7) Contribution of an individual's as member or leader
8) Clarity in written and oral communication

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