**E.G.S. PILLAY ENGINEERING COLLEGE, NAGAPATTINAM.**

**DEPARTMENT OF CIVIL ENGINEERING**

**COURSE PLAN**

**COURSE CODE : CE 6302 COURSE NAME :** **Mechanics Of solids**

**SEMESTER : III SEM. CIVIL. ENGG. – A&B SECTION ACADEMIC YEAR: 2016-2017**

**COURSE DURATION: JUNE – DECEMBER 2017 CLASS ROOM : PG 302 & 205**

**FACULTY DETAILS: BALASUBRAMANI.V, ASST .Prof/Civil. Engg.**

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| **PURPOSE** | To impart Knowledge about Mechanics of solids |
| **PREREQUISITE** | Engineering Mechanics |
| **COURSE OBJECTIVES** | 1. To impart fundamental concepts of Stress, Strain and deformation of solids with applications to bars, beams, trusses and thin cylinders. 2. To acquire the knowledge on mechanism of load transfer in beams, the induced stress resultants and deformations. 3. To develop the clear understanding of the effect of torsion, on shafts and springs. |
| **COURSE OUTCOME** | At the end of the course the student will be able to  1. Illustrate the fundamental concepts of stress and strain in various structural components and machines.(k2)  2. Calculate shear forces, bending moments in determinate beams with various loading conditions.(k3)  3. Estimate the deflection of beams.(k2)  4. Explain the effect of torsion in springs and shafts(k2)  5. Discuss about the two dimensional state of stresses.(k2) |

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| Course designed by | | Anna University, Chennai | | | | | |
| 1 | Category | | GENERAL  (G) | BASIC SCIENCES  (B) | | ENGINEERING SCIENCES  AND TECHNICAL ART  (E) | **PROFESSIONAL**  **SUBJECTS**  **(P)** |
|  |  | |  | **x** |
| 2 | Broad area | | **Structural** | | Environmental&  Water resource | Survey  &  Transportation | Construction Engineering |
| **x** | |  |  |  |
| 3 | Course co-coordinator | | | | | Balasubramani.V | |

**Direct assessment details**

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| **Name of assessment** | **Internal Marks** | **Topics** | **Duration** |
| Unit Test | 20 | Unit I | 2 periods |
| Daily Test 1 | Unit II | 1 period |
| Daily Test 2 | Unit III | 1 period |
| Daily Test 3 | Unit IV | 1 period |
| Cycle Test -1 | II & III Units | 3 Hrs |
| Cycle Test -2 | IV & V Units | 3 Hrs |
| Model Exam | Entire Syllabus | 3 Hrs |
| Assignments | Entire Syllabus |  |
| Innovative Assignment | Content Beyond Syllabus |  |
|  |  |  |  |
| Total | 20 |  |  |

**DETAILED LESSON PLAN**

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| UNIT I STRESS AND STRAIN   |  |  |  | | --- | --- | --- | | LECTURE | TUTORIAL | PRACTICAL | | 9 Hrs. | 3 Hr | 0 Hr |   Stress and strain at a point – Tension, Compression, Shear Stress – Hooke’s Law – Relationship among elastic constants – Stress Strain Diagram for Mild Steel, TOR steel, Concrete – Ultimate Stress – Yield Stress – Factor of Safety – Thermal Stresses – Thin Cylinders and Shells – Strain Energy due to Axial Force – Resilience – Stresses due to impact and Suddenly Applied Load – Compound Bars. | | | | | | | | | | | |
| **Session No** | **Topics to be covered** | | **Instruction Delivery** | | | | **Testing Method** | **Instructional objective** | | **Course Outcome** | |
| **Method** | | **Teaching Aids** | **Level** |
| **1** | Stress and strain at a point – Tension, Compression, Shear Stress | | Lecture with discussion | | PPT | Understand | Tests, Assignments | 1.To impart fundamental concepts of Stress, Strain and deformation of solids with applications to bars, beams, trusses and thin cylinders | | CO1. 1.At the end of the course, the student will be able to illustrate the fundamental concepts of stress and strain in various structural components and machines.(k2) | |
| **2** | Hooke’s Law – Relationship among elastic constants | |
| 3 |
| 4 | Stress Strain Diagram for Mild Steel, TOR steel, Concrete – Ultimate Stress – Yield Stress – Factor of Safety | |
| 5 | Thermal Stresses | |
| 6 |
| 7 | Thin Cylinders and Shells | |
| 8 | Strain Energy due to Axial Force – Resilience | |
| 9 | Strain Energy due to Axial Force– Resilience | |
| 10 | Stresses due to impact and Suddenly Applied Load | |
| 11 | Compound Bars. | |
| 12 |
| **CUMULATIVE HOURS = LECTURE -9, TUTORIAL – 3** | | | | | | | | | | | |
| **UNIT II SHEAR AND BENDING IN BEAMS**   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **9 Hrs.** | **3 Hr.** | **12 Hr.** |   Beams and Bending- Types of loads, supports – Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load, UDL, uniformly varying load. Theory of Simple Bending – Analysis of Beams for Stresses – Stress Distribution at a cross Section due to bending moment and shear force for Cantilever, simply supported and overhanging beams with different loading conditions - Flitched Beams. | | | | | | | | | | | |
| **Session No** | **Topics to be covered** | **Instruction Delivery** | | | | | **Testing Method** | | **Instructional objective** | | **Course Outcome** |
| **Method** | | **Teaching Aids** | | **Level** |
| **1** | Beams and Bending- Types of loads, supports | Lecture with discussion | | PPT | | Apply | Tests,  Assignments | | 2. To acquire the knowledge on mechanism of load transfer in beams, the induced stress resultants and deformations. | | CO2. At the end of the course, the student will be able to calculate shear forces, bending moments in determinate beams with various loading conditions |
| **2** | Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load, UDL, uniformly varying load. |
| **3** |
| **4** |
| **5** |
| **6** | Theory of Simple Bending – Analysis of Beams for Stresses |
| **7** |
| **8** | Stress Distribution at a cross Section due to bending moment and shear force for Cantilever, simply supported and overhanging beams with different loading conditions |
| 9 |
| 10 |
| 11 | **Flitched Beams.** |
| 12 |  | |
| **CUMULATIVE HOURS = LECTURE - 12, TUTORIAL - 6** | | | | | | | | | | | |

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| **UNIT III DEFLECTION**   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **9 Hrs.** | **3 Hr.** | **0 Hr.** |   Double integration method - Macaulay's methods - Area moment method - conjugate beam method for computation of slopes and deflections of determinant beams. | | | | | | | |
| **Session No** | **Topics to be covered** | **Instruction Delivery** | | | **Testing Method** | **Instructional objective** | **Course Outcome** |
| **Method** | **Teaching Aids** | **Level** |
| **1** | Double integration method for computation of slopes and deflections of determinant beams. | Lecture with discussion | PPT | Understand | Tests,  Assignments | 2. To acquire the knowledge on mechanism of load transfer in beams, the induced stress resultants and deformations | CO3. At the end of the course, the student will be able to estimate the deflection of beams. |
| **2** |
| **3** |
| **4** | Macaulay's methods for computation of slopes and deflections of determinant beams. |
| **5** |
| **6** |
| **7** | Area moment method for computation of slopes and deflections of determinant beams. |
| 8 |
| 9 |
| 10 | conjugate beam method for computation of slopes and deflections of determinant beams. |
| 11 |
| 12 |
| **CUMULATIVE HOURS = LECTURE - 27, TUTORIAL – 9** | | | | | | | |

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| **UNIT IV TORSION**   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **9 Hrs.** | **3 Hr.** | **0 Hr.** |   Torsion of Circular and Hollow Shafts – Elastic Theory of Torsion – Stresses and Deflection in Circular Solid and Hollow Shafts – combined bending moment and torsion of shafts - strain energy due to torsion - Modulus of Rupture – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Leaf Springs – Springs in series and parallel – Design of buffer springs. | | | | | | | | | | | | |
| **Session No** | **Topics to be covered** | | **Instruction Delivery** | | | | | **Testing Method** | | **Instructional objective** | | **Course Outcome** |
| **Method** | **Teaching Aids** | | **Level** | |
| **1** | Torsion of Circular and Hollow Shafts – Elastic Theory of Torsion | | Lecture with discussion, | PPT | | Understand | | Tests,  Assignments | | 1. To develop the clear understanding of the effect of torsion, on shafts and springs.  . | | CO4. At the end of the course,, the student will be able to explain the effects of torsion in springs and shafts |
| **2** |
| **3** | Stresses and Deflection in Circular Solid and Hollow Shafts | |
| 4 | combined bending moment and torsion of shafts | |
| 5 | strain energy due to torsion - Modulus of Rupture | |
| **6** | Power transmitted to shaft | |
| **7** | Shaft in series and parallel | |
| **8** | Closed Coiled helical springs | |
| **9** | Open Coiled helical springs | |
| **10** | Leaf Springs | |
| 11 | Springs in series and parallel | |
| 12 | Design of buffer springs. | |
| **CUMULATIVE HOURS = LECTURE - 36, TUTORIAL – 12** | | | | | | | | | | | | |
| **UNIT V COMPLEX STRESSES AND PLANE TRUSSES**   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **9 Hrs.** | **0 Hr.** | **0 Hr.** |   2 D State of Stress – 2 D Normal and Shear Stresses on any plane – Principal Stresses and Principal Planes – Mohr's circle - Plane trusses: Analysis of plane trusses - method of joints - method of sections | | | | | | | | | | | | |
| **Session No** | | **Topics to be covered** | **Instruction Delivery** | | | | **Testing Method** | | **Instructional objective** | | **Course Outcome** | |
| **Method** | | **Teaching Aids** | **Level** |
| **1** | | 2 D State of Stress – 2 D Normal and Shear Stresses on any plane | Lecture with discussion | | PPT | Understand | Tests,  Assignments | | 1. To impart fundamental concepts of Stress, Strain and deformation of solids with applications to bars, beams, trusses and thin cylinders | | CO5. 5.At the end of the course,, the student will be able to Discuss about the two dimensional state of stresses.(k2) | |
| **2** | |
| **3** | |
| 4 | | Principal Stresses and Principal Planes |
| **5** | |  |
| **6** | | Mohr's circle |
| 7 | |
| 8 | | Analysis of plane trusses |
| 9 | | method of joints |
| 10 | |
| 11 | | method of sections |
| 12 | |  | |
| **CUMULATIVE HOURS = LECTURE - 45, TUTORIAL - 15** | | | | | | | | | | | | |

**Text / Reference Books**

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| --- | --- | --- | --- |
| **Sl. No.** | **Title of the Book** | **Author(s)** | **Publisher** |
| **TEXT BOOKS** | | | |
| T1 | Strength of Materials | Rajput.R.K | S.Chand and Co, New Delhi, 2007 |
| T2 | Solid Mechanics | Bhavikatti. S | Vikas publishing house Pvt. Ltd, New Delhi, 2010 |
| **REFERENCES** | | | |
| R1 | 1. Fundamentals of Solid Mechanics | Gambhir. M.L., | PHI Learning Private Limited., New Delhi, 2009. |
| R2 | 1. “Mechanics of Materials”, | Timoshenko.S.B. and Gere.J.M, | Van Nos Reinbhold, New Delhi 1995. |
| R3 | 1. “Analysis of Structures”, Vol I | Vazirani.V.N and Ratwani.M.M, | Khanna Publishers, New Delhi,1995. |
| R4 | 1. “Mechanics of Structures”, Vol I, | Junnarkar.S.B. and Shah.H.J, | Charotar Publishing House, New Delhi 1997. |
| R5 | 1. "Mechanics of Materials", | Ugural. A.C., | Wiley India Pvt. Ltd., New Delhi, 2013. |
| **REFERENCE WEBSITES** | | | |
| 1 | <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/som%20Proc%20II/> | | |

**GAP ANALYSIS:**

To satisfy the Course:

Objective number 2. Acquire the knowledge on mechanism of load transfer in beams, the induced stress resultants and deformations) &

Course Outcome number 2. To calculate shear forces, bending moments, in determinate beams with various loading conditions (k3)

Content beyond syllabi Innovative Assignment will be given to the student through case studies problem which includes inclined, horizontal loadings combined with couple and conventional loading condition.

**COURSE INCHARGE**

**Programme Name: B.E. Civil Engineering**

**Programme Educational Objectives (PEOs):**

PEO1: Graduates will actively engage in problem solving using engineering principles to address the evolving needs of the society.

PEO2: Graduates will have successful career in civil engineering practice and research activities.

PEO3: Graduates will serve the society with professional ethics and integrity.

**Programme Outcomes (POs): Graduates will be able to**

(PO1) Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

(PO2) Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

(PO3) Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

(PO4) Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

(PO5) Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

(PO6) Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

(PO7) Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

(PO8) Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

(PO9) Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

(PO10) Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(PO11) Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

(PO12) Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

**Programme Specific Outcomes (PSOs):**

**Graduates will able to**

1. Graduates will be able to apply appropriate methodology for geotechnical, structural design and analysis, material selection, planning, scheduling estimation and costing, using modern tool in construction field.
2. To Service to the development of public health and environmental safety of the society with ethical values.
3. Pursue lifelong learning and professional development to face challenging and emerging needs of the society.

**Mapping Table: COs of CE6302: Mechanics Of Solids Vs POs & PSOs**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Course Outcomes (COs) |  | Program Outcomes (POs) | | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|  |  | K3 | K4 | K5 | K5 |  |  |  |  |  |  |  |  |
| CO1 | K2 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |
| CO2 | K3 | 3 | 2 | 1 |  |  |  |  |  |  |  |  |  |
| CO3 | K2 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |
| CO4 | K2 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |
| CO5 | K2 | 2 | 2 |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- |
| Course Outcomes (COs) |  | Program Specific Outcomes (PSOs) | | | | |
|  | | PSO1 | PSO2 | PSO3 | PSO4 |
|  |  | | K3 |  |  |  |
| CO1 | K2 | | 2 |  |  |  |
| CO2 | K2 | | 3 |  |  |  |
| CO3 | K3 | | 2 |  |  |  |
| CO4 | K2 | | 2 |  |  |  |
| CO5 | K2 | | 2 |  |  |  |

**Note: Adequate Support by the COs to Pos and PSOs: 3- High 2- Medium 1- Low**

**REVIEW OF PREVIOUS COURSE FACULTY REPORT AND ACTION TO BE TAKEN IN CONTENT DELIVERY METHOD:**

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| * A lecture with discussion approach will be applied to a solid mechanics course. |
| * All course material will be organized into classroom pairings. |
| * Lecture time will be used to explain and introduce new concepts, with limited problem solving. |
| * Students have to be prepared for classroom sessions by watching a series of presentation demonstrating problem solving techniques. |
| * During classroom meetings, students will be self organized into teams of 4 to work assigned problems at whiteboards with instructor guidance and feedback. |

* The classroom led to a small increase in average student achievement, which was assessed by comparing exam scores to a consistent exam from a previous semester.
* Lower performing students were more successful in this approach , while the performance of high achieving students did not change appreciably.
* Based on course evaluations, the student response to the classroom was overwhelmingly positive; however, some negative perceptions were expressed.