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

**DEPARTMENT OF CIVIL ENGINEERING**

**COURSE PLAN**

**COURSE CODE : CE6501 COURSE NAME :** **STRUCTURAL ANALYSIS-I**

**SEMESTER : V SEM – A & B Sec ACADEMIC YEAR : 2015-2016**

**COURSE DURATION : JULY – NOV 2016 CLASS ROOM : PG Block**

**FACULTY DETAILS : Ms.N.Karthika, Asst. Prof/ Civil Engineering**

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| **PURPOSE** | To analyze the indeterminate structures. |
| **PREREQUISITE** | Strength of materials |
| **INSTRUCTIONAL OBJECTIVES** | 1. To Understand the methods of analysis of indeterminate trusses for external loads, lack of fit and thermal effects and also the influence line concept for indeterminate structure.  2. To study behavior of arches, Settlement and temperature effects.  3. To understand the concept of analysis of determinate and indeterminate structures. |
| **INSTRUCTIONAL OUTCOME** | After completion of this course, students can able to  1. Find the deflection of pin jointed plane frames and rigid frames using energy and consistent deformation methods.(k2)  2. Determine absolute maximum bending moment and shear force in beams due to moving loads. (k2)  3. Determine the maximum moment, shear and stresses produced in arches due to external loads, temperature effects and support settlement.(k2)  4. Solve indeterminate structures using slope deflection method (k3)  5. Solve indeterminate structures using moment distribution method.(k3) |

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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 | | Construction | Structural | Geotechnical | Environmental |
|  | X |  |  |
| 3 | Course co-coordinator | | | | Ms.KARTHIKA.N | |

**Direct assessment details**

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

**DETAILED LESSON PLAN**

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| **UNIT I INDETERMINATE FRAMES** 12  Degree of static and kinematic indeterminacies for plane frames - analysis of indeterminate pin-jointed frames - rigid frames (Degree of statical indeterminacy up to two) - Energy and consistent deformation methods.   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **09 Hrs.** | **3 Hr.** | **0 Hr.** | | | | | | | | | | | | | | |
| **Session No** | **Topics to be covered** | **Instruction Delivery** | | | | | | **Testing Method** | | **Instructional objective** | | **Course Outcome** | |
| **Method** | | **Teaching Aids** | | **Level** | |
| 1 | Introduction about method of analysis. | Lecture with discussion | | PPT & Videos | | Understand | | Tests, Assignments | | To Understand the methods of analysis of indeterminate trusses for external loads, lack of fit and thermal effects. | | CO1: Students will be able to Find the deflection of pin jointed plane frames and rigid frames using energy and consistent deformation methods. | |
| 2 | Degree of static and kinematic indeterminacies for plane frames. |
| 3 | Analysis of indeterminate pin-jointed frames(Degree of statical indeterminacy up to two). |  | |
| 4 |
| 5 |
| 6 | Rigid frames (Degree of statical indeterminacy up to two) - |
| 7 |
| 8 |
| 9 | Energy and consistent deformation methods. |
| 1,2,3 | Tutorial 1- Analysis of indeterminate pin-jointed frames and rigid jointed frames. |
| **CUMULATIVE HOURS = LECTURE - 9, TUTORIAL – 3** | | | | | | | | | | | | | |
| **UNIT II MOVING LOADS AND INFLUENCE LINES 12**  Influence lines for reactions in statically determinate structures-Influence lines for member forces in pin jointed frames-influence lines for shear force and bending moment in beam sections-calculation of critical stress resultants due to concentrated and distributed moving loads.Muller Breslau’s principle-Influence lines for continuous beams and single storey rigid frames-Indirect model analysis for influence lines of indeterminate structures-Beggs deformeter.   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **18 Hrs.** | **06 Hr.** | **0 Hr.** | | | | | | | | | | | | | | |
| **Session No** | **Topics to be covered** | | **Instruction Delivery** | | | | | | **Testing Method** | | **Instructional objective** | | **Course Outcome** |
| **Method** | | **Teaching Aids** | | **Level** | |
| **1** | Influence lines for reactions in statically determinate structures | | Lecture with discussion | | PPT & Videos | | Understand | | Tests,  Assignments | | To Understand the influence line concept for indeterminate structures. | | CO2:Students can be able to determine absolute maximum bending moment and shear force in beams due to moving loads. |
| **2** | Influence lines for member forces in pin jointed frames | |
| **3** | Influence lines for shear force and bending moment in beam sections. | |
| **4** | Calculation of critical stress resultants due to concentrated and distributed moving loads. | |
| **5** |
| **6** | Muller Breslau’s principle-Influence lines for continuous beams. | |
| **7** | Muller Breslau’s principle-Influence lines for single storey rigid frames | |
| **8** | Indirect model analysis for influence lines of indeterminate structures-Beggs deformeter | |
| 9 |
| 4,5,6 | Tutorial 2- Influence lines for shear force and bending moment in beam sections& Muller Breslau’s principle-Influence lines for continuous beams. | |  | |  | |  | |  | |  | |  |
| **CUMULATIVE HOURS = LECTURE - 18, TUTORIAL – 6** | | | | | | | | | | | | | |

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| **UNIT III ARCHES** 12  Arches as structural Forms-Example of arch structures-Types of arches-Analysis of three hinged, two hinged and fixed arches, parabolic and circular arches-settlement and temperature effects.   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **27 Hrs.** | **09 Hr.** | **0 Hr.** | | | | | | | | |
| **Session No** | **Topics to be covered** | **Instruction Delivery** | | | **Testing Method** | **Instructional objective** | **Course Outcome** |
| **Method** | **Teaching Aids** | **Level** |
| **1** | Arches as structural Forms, Example of arch structures, Types of arches | Lecture with discussion | PPT & Videos | Understand | Tests,  Assignments | To study behavior of arches, settlement and temperature effects. | CO3: Students can be able to determine the maximum moment, shear and stresses produced in arches due to external loads, temperature effects and support settlement. |
| **2** | Analysis of three hinged arches |
| **3** |
| **4** | Analysis of two hinged arches |
| **5** |
| **6** | Analysis of fixed arches |
| **7** |
| **8** | Parabolic and circular arches |
| 9 | Settlement and temperature effects |
| 7,8,9 | Tutorial 3- Analysis of three hinged, two hinged and fixed arches. |  |  |  |  |  |  |
| **CUMULATIVE HOURS = LECTURE - 27, TUTORIAL – 9** | | | | | | | |

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| **UNIT IV SLOPE DEFLECTION METHOD 12**  Continuous beams and frames(with and without sway)-symmetry and anti symmetry-simplification for hinged end-support displacements   |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **36 Hrs.** | **12 Hr.** | **0 Hr.** | | | | | | | | | | | | | |
| **Session No** | **Topics to be covered** | | **Instruction Delivery** | | | | | **Testing Method** | | **Instructional objective** | | **Course Outcome** |
| **Method** | **Teaching Aids** | | **Level** | |
| **1** | Continuous beams( with and without sway) | | Lecture with discussion ,Tutorial Groups, | PPT & Videos | | Apply | | Tests,  Assignments | | To understand the concept of analysis of determinate and indeterminate structures. | | CO4: Students can be able to solve the indeterminate structures using slope deflection method. |
| **2** |
| **3** | Frames(with and without sway) | |
| 4 |
| 5 | Symmetry and anti symmetry | |
| **6** |
| **7** | Simplification for hinged end- Support displacements | |
| 8 |
| 9 |
| 10,11,12 | Tutorial 4-Continuous beams and rigid frames. | |  |  | |  | |  | |  | |  |
| **CUMULATIVE HOURS = LECTURE - 36, TUTORIAL – 12** | | | | | | | | | | | | |
| **UNIT V MOMENT DISTRIBUTION METHOD** 12  Distribution and carry over moments-Stiffness and carry over factors-analysis of continuous beams-Plane rigid frames with and without sway-Naylor’s simplification.     |  |  |  | | --- | --- | --- | | **LECTURE** | **TUTORIAL** | **PRACTICAL** | | **45 Hrs.** | **15 Hr.** | **0 Hr.** | | | | | | | | | | | | | |
| **Session No** | | **Topics to be covered** | **Instruction Delivery** | | | | **Testing Method** | | **Instructional objective** | | **Course Outcome** | |
| **Method** | | **Teaching Aids** | **Level** |
| **1** | | Distribution and carry over moments-Stiffness and carry over factors | Lecture with discussion , Tutorial Groups, | | PPT & Videos | Apply | Tests,  Assignments | | To understand the concept of analysis of determinate and indeterminate structures. | | CO5: Students will be able to solve the indeterminate structures using moment distribution method. | |
| **2** | | Analysis of Continuous beams |
| **3** | |
| 4 | |
| **5** | | Plane rigid frames with and without sway. |
| **6** | |
| 7 | |
| 8 | | Naylor’s simplification |  | |  |
| 9 | |
| 13,14,15 | | Tutorial 5- Continuous beams and rigid frames. |  | |  |  |  | |  | |  | |
| **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 | “Comprehensive Structural Analysis – Vol. 1 & Vol. 2” | Vaidyanadhan, R and  Perumal, P | Laxmi Publications Pvt. Ltd, New Delhi, 2003. |
| T2 | “Structural Analysis” | L.S. Negi & R.S. Jangid | Tata McGraw Hill Publications, New Delhi, 6th Edition, 2003. |
| T3 | "Theory of structures" | Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain | Laxmi Publications Pvt. Ltd., New Delhi, 2004 |
| T4 | "Basic Structural Analysis" | Reddy. C.S., | Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013. |
| T5 | "Structural Analysis – Vol. 1 & Vol. 2" | BhavaiKatti, S.S | Vikas Publishing Pvt Ltd., New Delhi, 2008 |
| **REFERENCES** | | | |
| R1 | “Indeterminate Structural Analysis” | Wang C.K. , | Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010 |
| R2 | “Structural Analysis” | Devadas Menon | Narosa Publishing House, 2008 |
| R3 | "Structural Analysis - A unified classical and matrix approach" | Ghali.A., Nebille and Brown. T.G., | Sixth Edition, SPON press, New York, 2013. |
| R4 | "Fundamentals of Structural Mechanics and Analysis" | Gambhir. M.L., | PHI Learning Pvt. Ltd., New Delhi, 2011. |
| **REFERENCE WEBSITES** | | | |
| 1 | http://nptel.iitm.ac.in | | |
| 3 | http://www.ce.iitb.ac.in/ | | |

**GAP ANALYSIS:**

1. To satisfy the Course Outcome number 4-Analysis of beams and frames using Slope deflection method(TUTORIAL-4)
2. To satisfy the Course Outcome number 5- Analysis of beams and frames using Moment distribution method(TUTORIAL-5)

**CONTENT BEYOND SYLLUBI:**

Innovative Assignments forthe following topics:

1. Analysis by slope deflection method and
2. Analysis by moment distribution method using system approach.

**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**

PSO1: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.

PSO2:Graduates will be able to service to the development of public health and environmental safety of the society with ethical values.

PSO3:Graduates will be able to pursue lifelong learning and professional development to face challenging and emerging needs of the society.

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**Mapping Table: COs of CE6501: STRUCTURAL ANALYSIS I Vs POs**

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

**Mapping Table: COs of CE6501: STRUCTURAL ANALYSIS I Vs PSOs**

|  |  |
| --- | --- |
| Course Outcomes (Cos) | CO LEVEL |
| PSO1 | PSO2 | PSO3 |
| PSO LEVEL | | K3 | K2 | K4 |
| CO1 | K2 | 2 | \_ | \_ |
| CO2 | K2 | 2 | \_ | \_ |
| CO3 | K2 | 2 | \_ | \_ |
| CO4 | K3 | 3 | \_ | \_ |
| CO5 | K3 | 3 | \_ | \_ |

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