# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**
Dundigal, Hyderabad -500 043

## CIVIL ENGINEERING

## COURSE DESCRIPTOR

| | | | | | |
|---|---|---|---|---|---|
| **Course Title** | **ADVANCED MATERIAL TESTING LABORATORY** | | | | |
| **Course Code** | ACE109 | | | | |
| **Programme** | B.Tech | | | | |
| **Semester** | VI | CE | | | |
| **Course Type** | Core | | | | |
| **Regulation** | IARE - R16 | | | | |
| **Course Structure** | **Theory** | | | **Practical** | |
| | **Lectures** | **Tutorials** | **Credits** | **Laboratory** | **Credits** |
| | - | - | - | 3 | 2 |
| **Chief Coordinator** | Mr. G. Rama Krishna, Associate Professor, CE | | | | |
| **Course Faculty** | Mr. G. Rama Krishna, Associate Professor, CE<br>Mr. K. Anand Goud, Assistant Professor, CE | | | | |

## I. COURSE OVERVIEW:

Advanced material testing laboratory provides a comprehensive coverage of practical aspects of the subject and include the latest developments in the field of concrete construction and students also understand the material behavior. The properties of concrete and its constituent materials of traditional concrete and self-compacting concrete and the role of various admixtures in modifying these properties to suit specific requirements, such as ready mix concrete, NDT techniques are used to locating defects as well as distinguish material properties. Understand the basic principles of various NDT techniques, nature of defects, standards and specifications related to NDT Testing.

## II. COURSE PRE-REQUISITES:

| Level | Course Code | Semester | Prerequisites | Credits |
|---|---|---|---|---|
| UG | ACE010 | V | Concrete Technology | 3 |
| UG | ACE108 | V | Concrete Technology Laboratory | 2 |

## III. MARKS DISTRIBUTION:

| Subject | SEE Examination | CIA Examination | Total Marks |
|---|---|---|---|
| Advanced Material Testing Laboratory | 70 Marks | 30 Marks | 100 |

## IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ✔ | Chalk & Talk | ✘ | Quiz | ✘ | Assignments | ✘ | MOOCs |
| ✔ | LCD / PPT | ✘ | Seminars | ✘ | Mini Project | ✔ | Videos |
| ✔ | Open Ended Experiments | | | | | | |

## V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

**Semester End Examination (SEE):** The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

| | |
|---|---|
| 20 % | To test the preparedness for the experiment. |
| 20 % | To test the performance in the laboratory. |
| 20 % | To test the calculations and graphs related to the concern experiment. |
| 20 % | To test the results and the error analysis of the experiment. |
| 20 % | To test the subject knowledge through viva – voce. |

**Continuous Internal Assessment (CIA):**
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

| **Component** | **Laboratory** | | **Total Marks** |
|---|---|---|---|
| **Type of Assessment** | Day to day performance | Final internal lab assessment | |
| **CIA Marks** | 20 | 10 | 30 |

**Continuous Internal Examination (CIE):**
One CIE exams shall be conducted at the end of the 16$^{th}$ week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

| **Preparation** | **Performance** | **Calculations and Graph** | **Results and Error Analysis** | **Viva** | **Total** |
|---|---|---|---|---|---|
| 2 | 2 | 2 | 2 | 2 | 10 |

## VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

| Program Outcomes (POs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| PO 1 | **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. | 2 | Tutorials |
| PO 2 | **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. | 2 | Calculations of the observations |
| PO 3 | **Design/development of solutions:** 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. | 1 | Practical's and problem solving from observations |
| PO 4 | **Conduct investigations of complex problems**: 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. | 2 | Practical's |
| PO5 | **Modern tool usage:** 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. | 1 | Practical's |
| PO7 | **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. | 1 | Tutorial |
| PO8 | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. | 2 | Tutorials |
| PO9 | **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. | 1 | Practical's |

**3 = High; 2 = Medium; 1 = Low**

## VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

| Program Specific Outcomes (PSOs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| PSO 1 | **Engineering knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication. | 3 | Tutorials |
| PSO 2 | **Broadness and diversity:** Graduates will have a broad understanding of economic, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage. | 2 | Tutorials/ Practicals |

| Program Specific Outcomes (PSOs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| PSO 3 | **Self-learning and service:** Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly. | - | - |

**3 = High; 2 = Medium; 1 = Low**

## VIII. COURSE OBJECTIVES :

| The course should enable the students to: | |
|---|---|
| I | Assess the physical properties of cement, sand and aggregate |
| II | Describe properties of various types of admixtures and their utility. |
| III | Measure important properties of fresh and hardened cement concrete. |
| IV | Understand the basic principles of various NDT techniques and various applications of NDT techniques. |

## IX. COURSE LEARNING OUTCOMES (CLOs):

| CLO Code | CLO's | At the end of the course, the student will have the ability to: | PO's Mapped | Strength of Mapping |
|---|---|---|---|---|
| ACE109.01 | CLO 1 | Determine the consistency, soundness, setting time and compressive strength of cement. | PO1, PO2,PO3, PO5, PO7, PO8, PO9 | 2 |
| ACE109.02 | CLO 2 | Determine the Fineness modulus of aggregates. | PO1, PO2,PO3, PO5, PO9 | 2 |
| ACE109.03 | CLO 3 | Understand the bulking of fine aggregates. | PO1, PO2,PO3, PO4, PO5, PO7, PO9 | 2 |
| ACE109.04 | CLO 4 | Determine the aggregate crushing and impact value. | PO1, PO2,PO3, PO4, PO5, PO7, PO9 | 1 |
| ACE109.05 | CLO 5 | Understand the workability of self-compacting concrete. | PO1, PO2,PO3, PO5, PO7, PO9 | 1 |
| ACE109.06 | CLO 6 | Determine the air content of freshly mixed concrete from observations. | PO1, PO2,PO3, PO4, PO5, PO9 | 1 |
| ACE109.07 | CLO 7 | Understand the fluidity of cement | PO1, PO4, PO5, PO7, PO9 | 2 |
| ACE109.08 | CLO 8 | Determine the optimum dosage of super plasticizer. | PO1, PO3, PO5, PO7, PO9 | 1 |
| ACE109.09 | CLO 9 | Determine the permeability of the concrete specimen. | PO1, PO2,PO3, PO5, PO7, PO9 | 1 |
| ACE109.10 | CLO 10 | Apply scientific and technical knowledge to the field of Non-Destructive Testing | PO1, PO2,PO3, PO4, PO5, PO9 | 1 |
| ACE109.11 | CLO 11 | Analyze the Accelerated Curing of concrete. | PO1, PO2,PO3, PO5 | 2 |
| ACE109.12 | CLO 12 | Evaluate the Influence of water cement ratio on strength and aggregate/cement ratio on workability and strength. | PO1, PO4, PO5, PO7, PO9 | 2 |
| ACE109.13 | CLO 13 | Synthesis the influence of different chemical admixtures on concrete. | PO, PO3, PO4, PO5, PO7, PO9 | 2 |

| CLO Code | CLO's | At the end of the course, the student will have the ability to: | PO's Mapped | Strength of Mapping |
|---|---|---|---|---|
| ACE109.14 | CLO 14 | Understand the concept of water cement ratio | PO1, PO2,PO3, PO4, PO5, PO7, PO9 | 1 |

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## X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

| Course Learning Outcomes (CLOs) | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CLO 1 | 3 | 3 | 1 | | 3 | | 2 | 2 | 1 | | | | 3 | 2 | |
| CLO 2 | 3 | 3 | 2 | | 2 | | | | 1 | | | | 2 | | |
| CLO 3 | 3 | 2 | 2 | 2 | 2 | | 1 | | 1 | | | | 3 | | |
| CLO 4 | 1 | 3 | 1 | 1 | 2 | | 1 | | 1 | | | | 2 | | |
| CLO 5 | 1 | 1 | 2 | 3 | 1 | | 2 | | 1 | | | | 3 | 1 | |
| CLO 6 | 2 | 3 | 1 | 1 | 1 | | | | 1 | | | | 3 | | |
| CLO 7 | 3 | 2 | 2 | 3 | 2 | | 1 | | 1 | | | | 3 | | |
| CLO 8 | 2 | | 2 | | 2 | | 3 | | 1 | | | | 3 | 3 | |
| CLO 9 | 3 | 1 | 2 | | 1 | | 1 | | 1 | | | | 3 | | |
| CLO 10 | 1 | 3 | 2 | 1 | 3 | | | | 1 | | | | 3 | | |
| CLO 11 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 | |
| CLO 12 | 3 | 2 | 2 | 2 | 2 | | 1 | | 1 | | | | 3 | | |
| CLO 13 | 3 | | 1 | 3 | 1 | | 3 | | 1 | | | | 3 | 2 | |
| CLO 14 | 1 | 2 | 1 | 2 | 2 | | 1 | | 1 | | | | 1 | | |

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## XI. ASSESSMENT METHODOLOGIES – DIRECT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CIE Exams | PO1, PO2,PO3, PO4, PO5, PO7, PO9 | SEE Exams | PO1,PO2,PO3, PO4, PO5, PO7, PO9 | Assignments | - | Seminars | - |
| Laboratory Practices | PO3, PO4, PO5, PO9 | Student Viva | PO1 | Mini Project | - | Certification | - |

## XII. ASSESSMENT METHODOLOGIES - INDIRECT

| | | | |
|---|---|---|---|
| ✔ | Early Semester Feedback | ✔ | End Semester OBE Feedback |
| ✘ | Assessment of Mini Projects by Experts | | |

## XIII. SYLLABUS

| LIST OF EXPERIMENTS | |
|---|---|
| **Week-1** | **TESTS ON CEMENT** |
| Tests on cement - Consistency, setting times, soundness, compressive strength | |
| **Week-2** | **GRADATION CHARTS OF AGGREGATES** |
| Study of gradation charts of aggregates. | |
| **Week-3** | **BULKING OF SAND** |
| Study of bulking of sand | |
| **Week-4** | **AGGREGATE CRUSHING AND IMPACT VALUE** |
| Measurement of aggregate impact test. | |
| **Week-5** | **WORKABILITY TESTS ON FRESH SELF-COMPACTING CONCRETE** |
| Measurement of workability tests on fresh self-compacting concrete | |
| **Week-6** | **AIR ENTRAINMENT TEST ON FRESH CONCRETE** |
| Measurement of air entrainment test on fresh concrete | |
| **Week-7** | **MARSH CONE TEST** |
| Performing marsh cone test on fresh concrete | |
| **Week-8** | **PERMEABILITY OF CONCRETE** |
| Performing permeability of concrete test on fresh concrete | |
| **Week-9** | **NON DESTRUCTIVE TESTING OF CONCRETE.** |
| Performing nondestructive testing of concrete | |
| **Week-10** | **ACCELERATED CURING OF CONCRETE** |
| Performing accelerated curing test on concrete | |
| **WeeK-11** | **INFLUENCE OF W/C RATIO ON STRENGTH AND AGGREGATE / CEMENT RATIO ON WORKABILITY AND STRENGTH** |
| Influence of W/C ratio on strength of concrete<br>Influence of aggregate / cement ratio on workability and strength | |
| **Week-12** | **INFLUENCE OF DIFFERENT CHEMICAL ADMIXTURES ON CONCRETE** |
| Finding the influence of different chemical admixtures on concrete | |

| Text Books: |
|---|
| 1. M.S. Shetty, " Concrete Technology, theory and practice", S. Chand publishing, revised edition, 2012<br>2. H.S. Moondra, Rajiv Gupta, "Laboratory Manual for Civil Engineering", CBS Publishers, New Delhi, 4th Edition, 2015. |
| **Reference Books:** |
| 1. S. K. Duggal, " Building materials" new age international publications, third revised edition, 2008<br>2. Hemant Sood, "Laboratory Manual on Testing of Engineering Materials", New Age International Publishers, New Delhi, 2nd Edition, 2007 |

## XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

| Week No. | Topics to be covered | Course Learning Outcomes (CLOs) | Reference |
|---|---|---|---|
| 1 | Tests on cement - Consistency, setting times, soundness, compressive strength | CLO1 | T1:2.27, 2.28,2.30, 2.29<br>R1:5.9 |
| 2 | Study of gradation charts of aggregates. | CLO2 | T1:3.23<br>R1:6.12 |
| 3 | Study of bulking of sand | CLO3 | T1:3.17<br>R1:6.8 |
| 4 | Measurement of aggregate crushing value and impact value. | CLO4 | T1:3.7,3.8<br>R1:6.12 |
| 5 | Measurement of workability on fresh self-compacting concrete | CLO5 | T1:13.2.1<br>R1:10.8 |
| 6 | Measurement of air entrainment of fresh concrete | CLO6 | T1:5.15.3<br>R1:10.9 |
| 7 | Performing marsh cone test on cement | CLO7, CLO8 | T1:5.9.2<br>R1:10.17 |
| 8 | Performing permeability of concrete test on fresh concrete | CLO9 | T1:9.7<br>R1:10.9 |
| 9 | Performing non destructive test of concrete | CLO10 | T1:10.11<br>R1:10.14 |
| 10 | Performing accelerated curing test on concrete | CLO11 | T1:7.5<br>R1:10.9 |
| 11 | Influence of W/C ratio on strength of concrete<br>Influence of aggregate / cement ratio on workability and strength | CLO12, CLO14 | T1:9.6<br>R1:10.4 |
| 12 | Finding the influence of different chemical admixtures on concrete | CLO13 | T1:5<br>R1:10.17 |

## XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

| S No | Description | Proposed actions | Relevance with POs | Relevance with PSOs |
|---|---|---|---|---|
| 1 | Workability test on Fresh Self – Compacting Concrete | NPTEL & Exercise Practices | PO1, PO2,PO3, PO5, PO7, PO9 | PSO1, PSO2 |
| 2 | Non-Destructive testing of concrete | Seminars / NPTEL | PO1, PO2,PO3, PO4, PO5, PO9 | PSO1 |
| 3 | Influence of different chemical admixtures on concrete | NPTEL | PO, PO3, PO4, PO5, PO7, PO9 | PSO1, PSO2 |

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