# CA8010: STRUCTURAL DYNAMICS AND APPLICATIONS

**Effective Term**
Semester B 2024/25

## Part I Course Overview

**Course Title**
Structural Dynamics and Applications

**Subject Code**
CA - Civil and Architectural Engineering
**Course Number**
8010

**Academic Unit**
Architecture and Civil Engineering (CA)

**College/School**
College of Engineering (EG)

**Course Duration**
One Semester

**Credit Units**
3

**Level**
R8 - Research Degree

**Medium of Instruction**
English

**Medium of Assessment**
English

**Prerequisites**
Nil

**Precursors**
Nil

**Equivalent Courses**
BC8010 Structural Dynamics and Applications

**Exclusive Courses**
Nil

**Additional Information**
Some courses offered in Summer Term may start a few weeks earlier than the normal University schedule. Please check the teaching schedules with CLs before registering for the courses.

# Part II Course Details

**Abstract**

This course aims at equipping students with knowledge in structural dynamics, stability and vibration control with a balanced scope on fundamentals, research and applications. Basic topics include single-degree-offreedom (SDOF) systems, multi-degree-of-freedom (MDOF) systems and continuous systems. It also includes advanced topics such as structural stability, random vibrations, damping in structures, vibration control, theory and dynamics of plates, wind and earthquake engineering.

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | establish governing equations for linear-elastic structural dynamics problems with common structural elements; | | | x | |
| 2 | apply effectively analytical and numerical techniques for analyzing dynamic response of SDOF and MDOF linearelastic structures under different characteristic types of loading; | | | x | |
| 3 | identify vibration problems and apply structural dynmaics concepts to its mitigation; | | | x | |
| 4 | apply probability theory to analysis of linear-elastic vibration of structures subjected to stochastic loads; | | | x | |
| 5 | perform vibration testing of structures using common techniques; | | | x | |
| 6 | apply structural dynamics to basic assessment of structural response due to wind and earthquake loads. | | | x | |
| 7 | discover the basic attributes affecting the dynamic response of structures | | | | x |

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

**Learning and Teaching Activities (LTAs)**

| | LTAs | Brief Description | CILO No. | Hours/week (if applicable) |
|---|---|---|---|---|
| 1 | Lectures | Structural dynamics; SDOF and MDOF systems; Wind and earthquake engineering; Stability of structures; Vibration control | 1, 2, 3, 4, 5, 6, 7 | 2 |
| 2 | Tutorials | Examples and applications in structural dynamics and earthquake engineering | 1, 2, 3, 4, 5, 7 | 1 |

**Additional Information for LTAs**

Semester Hours: 3 hours per week

Lecture/Tutorial/Laboratory Mix: Lecture (2); Tutorial (1); Laboratory (0)

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Assignments | 1, 2, 3, 4, 7 | 50 | |

**Continuous Assessment (%)**

50

**Examination (%)**

50

**Examination Duration (Hours)**

3

**Additional Information for ATs**

To pass a course, a student must obtain minimum marks of 30% in both coursework and examination components, and an overall mark of at least 40%

**Assessment Rubrics (AR)**

**Assessment Task**

Assignments (Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

**Criterion**

1. (CILO 1) Ability to establish the governing equations of motions for linear-elastic structures;
2. (CILO 2) Ability to analyze dynamic response of SDOF and MDOF linearelastic structures under wind or earthquake load;
3. (CILO 3) Ability to apply structural dynamics concepts to mitigate undesired structural vibrations;
4. (CILO 4) Ability to apply probability theory to analyse linear-elastic vibration of structures subjected to stochastic loads;
5. (CILO 7) Ability to identify the key factors affecting the dynamic responses of realistic structures.

**Excellent**

(A+, A, A-): Both the solution procedures and results are correct.

**Good**

(B+, B, B-): The solution procedures demonstrate a moderate level of understanding about the correct strategy and/or theory in resolving the given problems.

**Fair**

(C+, C, C-): The solution procedures demonstrate a few minor conceptual errors about the strategy and/or theory in resolving the given problems.

**Marginal**

(D): The solution procedures demonstrate major conceptual errors about the strategy and/or theory in resolving the given problems

**Failure**

(F): Not even reaching marginal levels

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**Assessment Task**

Examination (Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

**Criterion**

1. (CILO 1) Ability to establish the governing equations of motions for linear-elastic structures;
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**Marginal**

(D): The solution procedures demonstrate major conceptual errors about the strategy and/or theory in resolving the given problems

**Failure**

(F): Not even reaching marginal levels

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**Assessment Task**

Assignments (Applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

1. (CILO 1) Ability to establish the governing equations of motions for linear-elastic structures;
2. (CILO 2) Ability to analyze dynamic response of SDOF and MDOF linearelastic structures under wind or earthquake load;
3. (CILO 3) Ability to apply structural dynamics concepts to mitigate undesired structural vibrations;
4. (CILO 4) Ability to apply probability theory to analyse linear-elastic vibration of structures subjected to stochastic loads;
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**Good**

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**Marginal**

(B-, C+, C): The solution procedures demonstrate significant/ major conceptual errors about the strategy and/or theory in resolving the given problems.

**Failure**

(F): Not even reaching marginal levels

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**Assessment Task**

Examination (Applicable to students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

1. (CILO 1) Ability to establish the governing equations of motions for linear-elastic structures;
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**Failure**

(F): Not even reaching marginal levels

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# Part III Other Information

**Keyword Syllabus**

Single-degree-of-freedom (SDOF) systems: free vibration, harmonic loading, periodic loading, general loading. Multi-degree-of-freedom systems (MDOF): natural frequencies and modeshapes, modal analysis, time-stepping schemes. Distributed-parameter systems: governing PDE, eigenvalue problem. Stationary stochastic processes, random vibration of structures; wind engineering; earthquake engineering; structural vibration testing.

**Reading List**

**Compulsory Readings**

| | Title |
|---|---|
| 1 | Nil |

**Additional Readings**

| | Title |
|---|---|
| 1 | Clough, R. W. & Penzien, J. (1993), Dynamics of Structures, McGraw-Hill. |
| 2 | Simiu, E. & Scanlan, R. (1986). Wind Effects on Structures, Wiley-Interscience. |