**CIVL413 – Structures III**
**Syllabus**
**2nd Semester 2011/2012**

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| Coordinating Unit: | Department of Civil and Environmental Engineering, Faculty of Science and Technology | | |
| Supporting Unit(s): | Nil | | |
| Course Code: | CIVL413 | Year of Study: | 4 |
| Course Title: | Structures III | | |
| Compulsory/Elective: | Elective | | |
| Course Prerequisites: | CIVL314 Structures I | | |
| Prerequisite Knowledge: | Response of structures due to static load. Determination of internal forces and deformations of structures. | | |
| Duration: | One semester | Credit Units: | 3 |
| Class/Laboratory Schedule: | Three hours of lecture per week. | | |
| Laboratory/Software Usage: | Use of Matlab program | | |
| Course Description: | This course introduces dynamic behaviour of structures and methods to obtain structural response under dynamic load and base excitation. | | |
| Course Objectives: | 1. To introduce general dynamic behaviour of structures.<br>2. To introduce different types of dynamic loads: periodic load, impulsive load, general load and effective load due to base excitation.<br>3. To understand dynamic analysis of structures modeled by a single-degree-of-freedom, multi-degrees-of-freedom and distributed parameter system.<br>4. To understand earthquake response of simplified structures. | | |
| Learning Outcomes (LO): | 1. understand how to represent real structures by idealized structural systems [POs: a,e];<br>2. understand dynamic behaviour of single-degree-of-freedom systems and multi-degree-of-freedom system and be able to determine their dynamic response under dynamic load and excitation. [POs: a,e];<br>3. understand dynamic behaviour of continuous systems and be able to determine their dynamic response under dynamic load and excitation. [POs: a,e];<br>4. understand earthquake response [POs: a,e]<br>5. be able to use analytical and numerical methods to obtain dynamic response of structures [POs: a,e,l]; | | |

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| Texts & References:<br><br>*(* recommended textbook(s))* | 1. Ray W. Clough and Joseph Penzien, Dynamics of Structures, 2nd Edition, McGraw Hill, 2007.<br>2. Anil K. Chopra, Dynamics of Structures – Theory and Applications to Earthquake Engineering, Prentice-Hall. *<br>3. J. W. Smith, Vibrations of Structures – Application in Civil Engineering Design, Chapman and Hall, 1988. |
| Student Assessment: | • Assignments : 20%<br>• Tests : 40%<br>• Final examination: 40% |
| Learning Outcome Assessment: | • Tests and final examination.<br>• Course evaluation |
| Pedagogical Methods: | ☑ Lecture<br>☐ Guest speakers<br>☐ Case study<br>☐ Role playing<br>☐ Student presentation<br>☐ Project<br>☐ Simulation game<br>☑ Exercises and problems<br>☐ Service learning<br>☐ Internship<br>☐ Field study<br>☐ Company visits<br>☐ e-learning<br>☐ Independent study<br>☑ Others : computation using Matlab |

| Major Assessment Methods: | Case Study | Role Playing | Student Presentation | Individual project/paper | Group project/paper | Simulation Game | Exercises & problems | Service learning | Internship | Field Study | Company visits | Written examination | Oral examination | Others (please specify) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assignment(s) (20%) | | | | | | | ✓ | | | | | | | |
| Test(s) (40%) | | | | | | | | | | | | ✓ | | |
| Examination (40%) | | | | | | | | | | | | ✓ | | |
| Others | | | | | | | | | | | | | | |
| Course Web: (if any) | | | | | | | | | | | | | | |

Course Content: (topic outline)

| Week no. | Topics | Assignment no. | LO no. |
|---|---|---|---|
| 1 | **Introduction of Structural Dynamics**<br>Dynamic response vs static response. Dynamic loads. Method of analysis. | -- | 1 |
| 2, 3 | **Vibration of SDOF System**<br>Free vibration. Damping. Forced vibration. Periodic Loads. Impulsive Load. General Loading. Generalized SDOF system. Four-way logarithmic graph. | 1 | 1, 2 |
| 4, 5 | **Earthquake Response of SDOF System**<br>Numerical methods for solving the differential equations of motion. Earthquake excitation. Response spectra concept. Response spectra analysis. | 2 | 1, 4, 5 |
| 6, 7 | **Vibration of MDOF System**<br>Equations of motion. Evaluation of mass, stiffness matrices and loading. Determination of natural frequencies and vibration modes. Orthogonal properties of natural vibration modes. Static condensation. Free vibration of undamped MDOF system. | 3 | 1, 2, 5 |
| 8, 9 | **Vibration of MDOF System**<br>Free vibration of classically damped MDOF system. Force vibration of MDOF system. Modal analysis. Numerical evaluation of dynamic response of MDOF system. Earthquake analysis of MDOF system. | 4 | 1, 4, 5 |
| 10 | **Test 1** | -- | -- |
| 11, 12 | **Systems with distribution mass and elasticity**<br>Free vibration of uniform cantilever beam. Modal orthogonality and modal analysis of continuous system. | 5 | 1, 3, 5 |
| 13 | **Introduction to Earthquakes and Earthquakes structural design**<br>Causes of earthquakes. Tectonic Earthquakes. Seismic Waves. Earthquake Intensity. Earthquake Magnitude. Earthquake ground motion. Earthquakes structural design according to Chinese code and Macau code. | -- | 4, 5 |
| 14 | **Test 2** | -- | 5 |
| To be scheduled | **Final Examination** | -- | -- |

**Percentage Content of:**

| Math | Engineering Science | Engineering Design and Synthesis | Complementary Studies | Computer Studies | Total |
|---|---|---|---|---|---|
| 0 | 75 | 20 | 0 | 5 | 100 |

**Timetabled work in hours per week:**

| Lecture | Tutorial | Laboratory | Other | Total |
|---|---|---|---|---|
| 3 | --- | --- | --- | 3 |

**Contribution to Program Outcomes:**

| Program Outcomes | Contribution to POs# 5 ----------> 1 Significant Least | | | | |
|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 |
| (a) apply knowledge of mathematics, science, and engineering | ✓ | | | | |
| (b) design and conduct experiments, and analyze data | | | | | |
| (c) design components, systems or processes in presence of constraints | | | | | |
| (d) Function in a multi-disciplinary team | | | | | |
| (e) Engineering problem solving | ✓ | | | | |
| (f) Understand professional and ethical responsibility | | | | | |
| (g) Communicate effectively | | | | | |
| (h) Understand the impact of engineering solutions to the society | | | | | |
| (i) Recognize the need and have the ability for lifelong learning | | | | | |
| (j) Have knowledge of contemporary issues | | | | | |
| (k) Apply the skills, techniques, modern engineering tools | | | | | |
| (l) Apply the computer/IT tools relevant to the discipline | | | ✓ | | |

*# Note* 5: Significant contribution; 4: Supporting contribution; 3: Moderate contribution; 2: Marginal support; 1: Least support

**Course Instructor(s):** Dr. LAM Chi Chiu