

## **Syllabus**

## Course Description

| Course Title                     | Advanced topics on machine design   |
|----------------------------------|---|
| Course Code                      | 47555   |
| Course Title Additional          |   |
| Scientific-Disciplinary Sector   | ING-IND/14  |
| Language                         | English   |
| Degree Course                    | Master in Industrial Mechanical Engineering   |
| Other Degree Courses<br>(Loaned) |   |
| Lecturers                        | Prof. Franco Concli, Franco.Concli@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/34279   |
| Teaching Assistant               |   |
| Semester                         | Second semester   |
| Course Year/s                    | 1   |
| СР                               | 5   |
| Teaching Hours                   | 32  |
| Lab Hours                        | 12  |
| Individual Study Hours           | 81  |
| Planned Office Hours             |   |
| Contents Summary                 | The course aims to introduce the design mind-set and the main methods for the design of mechanical systems, to provide exposure to the practice of design through application and to encourage understanding of the broader implications of design. Students will learn, in the first module, fundamental concepts and methodologies for understanding and modelling mechanical systems.  In the second module, the theory of numerical finite element methods is introduced. Emphasis is given to practical applications, especially considering the advantages achievable with the latest technologies. |



| Course Topics             | PART 1: Material behavior and basic concepts                       |
|---------------------------|--|
|                           | 1. Principle of virtual work                                       |
|                           | 2. Force Method for the solution of Hyperstatic Structures         |
|                           | 3. Multi-axial fatigue criteria                                    |
|                           | a. Critical plane concepts   |
|                           | 4. Low cycle fatigue of materials                                  |
|                           | a. Masing Hp.  |
|                           | b. Ramberg-Osgood eq.  |
|                           | c. Neuber Hp.  |
|                           | d. Basquin-Coffin-Manson eq.                                       |
|                           | e. Loading spectra   |
|                           | PART 2: Machine Elements   |
|                           | 5. Shafts and shaft components                                     |
|                           | a. Interference fits (shaft-hub connection)                        |
|                           | b. Deflections   |
|                           | 6. Gears   |
|                           | a. Failure modes (bending - pitting - micro pitting - scuffing)    |
|                           | b. Gear types (spur - helical - bevel - worm)                      |
|                           | c. Gear configurations (parallel axis, orthogonal axis, planetary) |
|                           | d. Synthetic factors (sizing)                                      |
|                           | e. Strength calculation (ISO 6336)                                 |
|                           | f. Gear stiffness (Deformation under load)                         |
|                           | g. Examples of gearboxes (motorcycle and car transmissions)        |
|                           | 7. Bolted connections (screwed joints)                             |
|                           | a. Pretension  |
|                           | b. Tearing   |
|                           | c. Sheet yielding  |
|                           | 8. Welded connections  |
|                           | a. Pressure vessel.  |
| Keywords                  | Machine elements   |
| Recommended Prerequisites | Machine Design.  |
| Propaedeutic Courses      |  |
| Teaching Format           | The topics are presented by the professor by means of Power Point  |
|                           | presentations or the blackboard.                                   |
|                           | A selection of the material presented in class as well as online   |
|                           | resources and useful material will be available in the OLE         |
|                           | database/.   |
|                           | Further deepening material will be supplied or recommended by      |



|  | the teacher.   |
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| Mandatory Attendance   | Recommended  |
| Specific Educational Objectives and Learning                             | Knowledge and understanding:  1) Handle the analysis methods used in structural design of  |
| Outcomes   | mechanical systems.  |
|  | Applying knowledge and understanding:  2) Know how to face a new project of a mechanical system starting from its functional design.   |
|  | Making judgements:  3) Identify the critical zones and the corresponding stress states of all components of a mechanical system, under service loading conditions.  4) Choose the geometry and materials able to satisfy the |
|  | requirements of each component in terms of strength, deformation, fatigue life, and so on and realize the technical drawing of the system.   |
|  | Communication skills: 5) Oral communication skills (technical language)  |
|  | Learning skills:  6) Ability to autonomously extend the knowledge acquired.  |
| Specific Educational Objectives and Learning Outcomes (additional info.) |  |
| Assessment   | - Formative assessment   |
|  | In class and exercises and activities (2,3,4)  |
|  | - Summative assessment   |
|  | The assessment of the course is:   |
|  | Written exam   |
|  | 3/4 exercises  |
|  | Oral Exam  |
|  | Open-ended questions   |
|  | - Theoretical knowledge (40%)  |
|  | - Ability to provide examples/applications of the theoretical  |
|  | concepts (30%)  Ability to establish relationships between tonics (30%)  |
|  | - Ability to establish relationships between topics (20%)  |

|   | - Mastery of language (also with respect to teaching language) (10%).  |
|---|--|
| Evaluation Criteria                     | The final mark will be obtained combining the evaluations of the final written test and of the oral examination.   |
| Required Readings                       | Lecture notes and documents for exercise will be available on the reserve collections  There is no single textbook that covers the entire course. The course material is collected from various sources that will be announced during the course.  A selection of the material presented in class and useful material will be available in the course reserve collection database. |
| Supplementary Readings                  | R.S.KHURMI AND J.K. GUPTA, A Textbook of Machine Design, S Chand (ENG)  Shigley's Mechanical Engineering Design, McGraw-Hill (ENG)  G. NIEMANN, H. WINTER, Maschinenelemente, Springer (GER)  P. HAEFELE, L. ISSLER, H. RUOSS, fertigkeitslehre –  Grundlagen, Springer (GER)  P. DAVOLI, M. FILIPPINI, C. GORLA, A. LO CONTE, Lezioni sugli organi di macchine, Politecnica (ITA) |
|   | P. DAVOLI, A. BERNCASCONI, M. FILIPPINI, S. FOLETTI, Comportamento meccanico dei materiali, McGraw-Hill (ITA)  |
| Further Information                     |  |
| Sustainable Development<br>Goals (SDGs) | Industry, innovation and infrastructure, Quality education   |