Tárgytematika / Course Description

Dynamics of Machines

GKNM_AMTA008

Tárgyfelelős neve / Teacher's name: dr. Pere Balázs
Félév / Semester: 2019/20/2
Beszámolási forma / Assesment: Vizsga
Tárgy heti óraszáma / Teaching hours(week): 2/2/0
Tárgy féléves óraszáma / Teaching hours(sem.): 0/0/0

OKTATÁS CÉLJA / AIM OF THE COURSE

The subject presents the dynamical analysis, design, and principles of safe operation of machines on the base of knowledge of mathematics and physics acquired in previous studies. Numerical/computer methods are presented for the real engineering structure in the lab seminars.

TANTÁRGY TARTALMA / DESCRIPTION

week 1 Derivation of dynamical quantities of rigid bodies: linear momentum, angular momentum, mechanical energy, moment of inertia.
week 2 Mechanical theorems related to rigid bodies: theorem of linear momentum, theorem of
angular momentum, theorem of power.
week 3 Dynamic modeling. Determination of mass, moment of inertia, spring constant and Lehr's damping, solution of motion equation.
week 4 Unbalanced forces of a crank mechanism: introducing a replacement model. Harmonic
series of the unbalanced forces. Interpretation and analysis of the results.
week 5 Unbalanced moments of a crank mechanism: introducing a replacement model. Harmonic series of the unbalanced moments. Interpretation and analysis of the results.
week 6 Possibilities for balancing the crank mechanism: balancing harmonic inertial forces, complementary mechanism for balancing harmonic inertial forces, perfect balancing
of inertial forces. Possibilities of balancing torqueus.
week 7 Vibrations of an elastically embedded single-cylinder engine. Determination of relative and absolute coordinates of the piston. Determination of its velocity and kinetic energy. Derivation of the equation of motion of the engine at constant angular velocity.
week 8 Vibration of a spatial (3D) machine base. United model of the machine base and machine. Derivation of equation of motion for non-damped vibrations. Eigen modes and excited vibrations of the machine base.
week 9 Critical revolution of rotating body, Laval rotor, acceleration behind the critical revolution. Analytical solution of the problem.
week 10 Static and dynamic unbalance of a rotating wheel, determination of unbalanced

support forces. Theoretical possibilities of wheel balancing. Practical balancing of the wheel.
week 11 Dynamics of machines that can be modeled as a mechanism with one degree of freedom made from rigid bodies. Derivation of the equation of motion (Eksergian's equation). Examination of motion in case of a conservative force field.
week 12 Example of machines that can be modeled as a mechanism with one degree of freedom made from rigid bodies: equation of motion of an electric vehicle and its analytic solution.
week 13 Example of machines that can be modeled as a mechanism with one degree of freedom made from rigid bodies: numerical studies of a coulisse mechanism and a compressor.

SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESMENT'S METHOD

Two times in the semester (somewhen in the 6th and 12th weeks) **tests will be given** from the topics of the lectures of the previous weeks. Each tests are worth maximum 20 points.
At the end of the semester **a problem must be solved with Scilab software in a computer room**. The flawless solution **is worth 20 points.** The computer midterm test is **not obligatory.**

If one reaches at least 30 points in the two midterm tests, (s)he gets an offered grade.
30-34 points good (4)
35-40 points excellent (5)

Conditions for signature (to be fulfilled during the class-period and necessary for acquiring the grade):
At least **6 points** (from 40 points) must be reached in the **two midterm tests**.
If some one does not reach 6 point in the two midterm tests, (s)he can write a retake test in the last week. The maximum is
20 points in this test. At least 6 points are needed for the signature.

Exam (grade):
The sum of the points of the mid-term tests, the problem solved with computer, and the exam determines the mark. The grading is as follows
0-55 points fail (1)
56-71 points pass (2)
72-87 points satisfactory (3)
88-105 points good (4)
106-140 points excellent (5)
Students must provide proof of their identity with an official card (eg. ID card, passport, driving license, etc.) at the tests. Those students, who apply unauthorized means (book, lecture notes, infocommunication means, etc.) different from those
listed in the course requirement or adopted by the lecturer in charge of the course assessment will be disqualified from the
exam as a consequence of their action, and the exam mark will automatically become "Fail (1)".

Consultation:
Each lecturer will have one hour per week for consultation. Time and place will be determined according to the needs of students.

KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

Szabó T.: Szerkezetek dinamikája, MSc jegyzet, Universitas-Győr Nonprofit Kft., 2012.