Course description

Department/Unit /	KME / MECH2			**Academic Year**	2023/2024	
Title	Mechanics 2			**Type of completion**	Exam	
Accredited/Credits	Yes, 4 Cred.			**Type of completion**	Combined	
Number of hours	Lecture 2 [Hours/Week] Tutorial 2 [Hours/Week]					
Occ/max	Status A	Status B	Status C	**Course credit prior to**	YES	
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	YES	
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	10	
Timetable	Yes			**Repeated registration**	NO	
Language of instruction	Czech, English			**Semester taught**	Summer semester	
Optional course	Yes			**Internship duration**	0	
Evaluation scale	1|2|3|4			**Ev. sc. – cred.**	S|N	
No. of hours of on-premise						
Auto acc. of credit	No					
Periodicity	K					
Substituted course	None					
Preclusive courses	N/A					
Prerequisite courses	N/A					
Informally recommended courses	KME/DMECH or KME/MECHB or KME/MECH1					
Courses depending on this Course	N/A					

Course objectives:

Introduce the students firstly with
- kinematical solution of plane mechanisms using analytical and graphical methods
- statical solution of plane mechanisms using analytical and graphical methods
The students are introduced to the solution of plane problems from mass point, rigid body and rigid body systems dynamics. The student will be introduced with the basic ideas of the oscillation theory of linear rigid body systems with one degree of freedom.

Requirements on student

Credit requirements
The elaboration and delivery of the semestral work of adequate level.
Credit obtained in previous years of study is not accepted.

Exam requirements
Active knowledge of lectures and the capability to apply the acquired knowledge to the solution of concrete problems. The exam is divided into two parts: a written test and an oral exam. To take the oral exam, it is necessary to write the test and earn at least fifty percent (50%) of total points.

Content

1th week:
Lecture - Kinematical solution of plane mechanisms (analytical and graphical methods)
Practice - Composition of plane rigid body systems. Illustration of mechanical models of chosen mechanisms.
2nd week:
Lecture - Statical solution of stationary plane rigid bodies systems (analytically and graphically). Methods of release. Truss systems.
Practice - Kinematical solution of plane mechanisms - analytical and graphical solution.
3rd week:

Lecture - Statical solution of planar mechanisms - analytical and graphical solution.
Practice - Statical solution of stationary plane rigid bodies systems - analytical and graphical solution.
4th week:
Lecture - Mass point dynamics. Motion equation and its solution. Dynamical equilibrium condition. Mass point relative motion. Theorems of mass point motion.
Practice - Statical solution of planar mechanisms - analytically and graphically.
5th week:
Lecture - Mass points systems dynamics. D'Alembert's principle and theorems of motion.
Practice - Examination of mass point motion considering the motion equations and dynamical equilibrium conditions. Application of theorems of mass point motion.
6th week:
Lecture - Rigid body dynamics. Centre of mass, inertia matrix, liner momentum, angular momentum and kinetic energy.
Practice - Examination of relative mass point motion. Application of d'Alembert principle and theorems of motion to mass points system.
7th week:
Lecture - Translation and rotation of rigid body. Inertial effects on a rotor.
Practice - Examination of momentum of inertia and deviation momentum.
8th week:
Lecture - General plane motion of a rigid body.
Practice - Examination of rigid body translation. Run up and slowing down of a rotor. Reaction in the bearing due to the rotor imbalance.
9th week:
Lecture - Dynamics of planar systems. Method of release.
Practice - Examination of rigid body motion by rolling. Inertial effects on the rigid body by the general plane motion.
10th week:
Lecture - Method of mass reduction. Methods of motion equations integration.
Practice - Kinetostatical solution of planar mechanisms by the method of release.
11th week:
Lecture - Application of motion theorems. Impulse of bodies. Elementary theory of impulse. Examples.
Practice - Examination of planar mechanisms motion by the method of mass reduction. Computational simulation of rigid bodies systems with variable transmissions. Semestral work setting.
12th week:
Lecture - Principle ideas of oscillation theory. Mathematical models of linear systems with one degree of freedom. Free oscillations.
Practice - Eigen frequencies and free oscillation of undamped and damped systems with one degree of freedom.
13th week:
Lecture - Excited oscillation of linear systems with one degree of freedom. Impulse, transient and amplitude characteristics.
Practice - Steady harmonically excited oscillation. Kinematical excitation and excitation due to the rotor imbalance.

Fields of study

Guarantors and lecturers

- **Guarantors:** Prof. Ing. Jan Vimmr, Ph.D. (100%)

Literature

- **Recommended:** BROUSIL, J. - SLAVÍK, J. - ZEMAN, V. *Dynamika*. 1. vyd. Praha : SNTL, 1989. ISBN 80-03-00164-1.
- **Recommended:** HLAVÁČ, Z. *Dynamika pro kombinované studium*. Skriptum ZČU v Plzni, 2004. ISBN 80-7043-279-9.
- **Recommended:** Zeman, Vladimír. *Dynamika v příkladech*. reedice. Plzeň : ZČU, 1997. ISBN 80-7082-292-9.
- **Recommended:** ZEMAN, V. - HLAVÁČ, Z. *Kmitání mechanických soustav*. Skriptum ZČU v Plzni, 2004. ISBN 80-7043-337-X.
- **Recommended:** HLAVÁČ, Z. - VIMMR, J. *Sbírka příkladů ze statiky a kinematiky*. Skriptum ZČU v Plzni, 2007.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Preparation for an examination (30-60)	50
Undergraduate study programme term essay (20-40)	25
Contact hours	52
Total:	**127**

assessment methods

Knowledge - knowledge achieved by taking this course are verified by the following means:

Combined exam

Seminar work

Demonstrace znalostí při cvičeních

Skills - skills achieved by taking this course are verified by the following means:

Combined exam

Skills demonstration during practicum

Seminar work

Competences - competence achieved by taking this course are verified by the following means:

Seminar work

prerequisite

Knowledge - students are expected to possess the following knowledge before the course commences to finish it successfully:

znát základy vektorového a maticového počtu

znát základy diferenciálního a integrálního počtu a orientovat se v metodách pro derivování a integrování

rozumět teorii silových soustav

orientovat se a vysvětlit základní pojmy z oblasti statiky a kinematiky hmotného bodu a tělesa

Skills - students are expected to possess the following skills before the course commences to finish it successfully:

schopnost derivovat a integrovat základní typy funkcí

umět napsat příslušné podmínky rovnováhy a ekvivalence pro rovinnou a prostorovou soustavu sil o společném působišti, pro rovinnou a prostorovou soustavu rovnoběžných sil a pro obecnou rovinnou a prostorovou soustavu sil

umět řešit kinematiku hmotného bodu a tělesa

umět řešit statiku hmotného bodu a tělesa (úloha síly, úloha polohy)

Competences - students are expected to possess the following competences before the course commences to finish it successfully:

N/A

N/A

N/A

N/A

teaching methods

Knowledge - the following training methods are used to achieve the required knowledge:

Interactive lecture

Practicum

Individual study

Task-based study method

Skills - the following training methods are used to achieve the required skills:

Interactive lecture

Practicum

Individual study

Task-based study method

Competences - the following training methods are used to achieve the required competences:

Lecture

Practicum

learning outcomes

Knowledge - knowledge resulting from the course:

orientovat se v kinematickém řešení rovinných mechanismů

orientovat se ve statickém řešení rovinných soustav těles

popsat pohyb hmotného bodu pomocí pohybové rovnice, podmínek dynamické rovnováhy a pomocí vět o pohybu

umět popsat základní charakteristiky (hybnost, moment hybnosti a kinetická energie) posuvného, rotačního a obecného rovinného pohybu tělesa

umět vyjádřit setrvačné účinky pro posuvný, rotační a obecný rovinný pohyb tělěsa

definovat úlohu kinetostatiky a vlastní dynamiky

vysvětlit základní principy metody uvolňování a metody redukce hmot a silových účinků

rozumět elementární teorii rázu posouvajících se těles

rozpoznat volné a vynucené kmitání lineárních soustav s jedním stupněm volnosti

Skills - skills resulting from the course:

umět použít analytické metody pro kinematické řešení rovinných mechanismů

umět použít grafické metody pro vyšetřování rychlostí bodů a těles u rovinných mechanismů

provést statické řešení rovinných soustav těles pomocí analytických a grafických metod

umět řešit pohyb hmotného bodu aplikací pohybové rovnice, podmínek dynamické rovnováhy a vět o pohybu

řešit posuvný, rotační a obecný rovinný pohyb tělesa

aplikovat metodu uvolňování pro řešení úlohy kinetostatiky a vlastní dynamiky

aplikovat metodu redukce hmot a silových účinků pro sestavení vlastní pohybové rovnice

vyšetřit odezvu na volné a vynucené kmitání lineárních soustav s jedním stupněm volnosti

Competences - competences resulting from the course:

N/A

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Computer Modelling in Technology	Bachelor	Full-time	Computations and Design	1	2018	2023	Povinné předměty	A	2	LS
Computer Modelling in Technology	Bachelor	Full-time	Computations and Design	1	2023	2023	Povinné předměty	A	2	LS
Computer Modelling in Technology	Bachelor	Full-time	Computer Modelling	1	2023	2023	Povinné předměty	A	2	LS
Computer Modelling in Technology	Bachelor	Full-time	Computer Modelling	1	2018	2023	Povinné předměty	A	2	LS
Design	Bachelor	Full-time	Design, specialization Industrial Design	1	4	2023	Povinně volitelné - specializační - FAV	B	2	LS
Geomatics	Postgraduate Master	Full-time	Geomatics	1	2020	2023	Povinně volitelné předměty specializační	B	1	LS