Politechnika Krakowska im. Tadeusza Kościuszki

Karta przedmiotu

obowiązuje studentów rozpoczynających studia w roku akademickim 2012/2013

Wydział Inżynierii Lądowej

Kierunek studiów: Budownictwo

Profil: Ogólnoakademicki

Forma sudiów: stacjonarne

Kod kierunku: BUD

Stopień studiów: I

Specjalności: Bez specjalności - studia w języku angielskim

1 Informacje o przedmiocie

Nazwa przedmiotu	Mechanika teoretyczna
Nazwa przedmiotu w języku angielskim	Theoretical Mechanics
Kod przedmiotu	WIL BUD oIS B12 12/13
Kategoria przedmiotu	Przedmioty podstawowe
Liczba punktów ECTS	9.00
Semestry	2 3

2 Rodzaj zajęć, liczba godzin w planie studiów

Semestr	Wykład	Ćwiczenia audytoryjne	Laboratoria	Laboratoria komputerowe	Projekty	Seminarium
2	30	0	0	0	15	0
3	30	0	0	0	15	0

3 Cele przedmiotu

Cel 1 Introduce the basic concepts describing forces existing in engineering. Acquaint of the students with the idea of reduction of systems of forces.

Cel 2 Familiarize the students with the problems of kinematics of a particle and a rigid body to the extent enabling the formulation and analysis of motion of the simple mechanical systems.

Cel 3 Familiarize the students with the concepts of statisc. The acqusition of the skills of identification and formation of the statically determinate structures, and determining reactions at supports for statically determinate structures.

Cel 4 Acquaint the students with the dry and viscose models of friction and the idea of the cone of friction.

Cel 5 Familiarize the students with dynamics of a particle under smooth and non-smooth constraints, and dynamics of the system of particles and rigid bodies.

Cel 6 Acquaint the student with the selected problems of the analytical mechanics to the extent enabling the formulation of the differential equations of motion of the material system, and analysing their stability of equilibrium.

4 Wymagania wstępne w zakresie wiedzy, umiejętności i innych kompetencji

1 The first semester of the mathematics course must be copmleted.

5 Efekty kształcenia

EK1 Wiedza A student understands and explains the basic concepts of the theory of the equivalence of the systems of forces.

EK2 Umiejętności For an arbitrary force system (planar and spatial) a student can determine the equivalent couple-force system at a given point , and the simplest equivalent force system.

EK3 Wiedza A student defines the basic kinematic quantities occuring in the motion of a particle and a rigid body and describes relations between them.

EK4 Umiejętności A student can analyse statical determinacy and stability of the structures, and determine the reactions at supports and the forces in truss members for statically determinate structures.

EK5 Wiedza A student describes the friction phenomenon in civil engineering.

EK6 Wiedza A student describes the basic quantities of dynamics of a particle and a rigid system, and is able to analyse the tensor of inertia of any rigid body.

EK7 Umiejętności A student can analyse free, dumped and forced vibrations of the simple construction elements modelled as systems with the single degree of freedom.

EK8 Wiedza A student is capable of forming the differential equations of motion of material systems by means of the methods of analytical mechanics.

6 Treści programowe

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W1	Introduction to mechanics: fundamental concepts, division, mechanics and engineering	1

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W2	Forces and force systems: moment of a force about a point, moment of the force about a line, a system of forces, moment transport theorem and corollaries, a couple- definition and properties, equivalent systems of forces, elementary transformations of the force system, reduction of the force system to a force-couple system at a chosen point, the simplest equivalent force system (zero force system, resultant force, couple, wrench), the central axis of the system, special force systems : planar force system, concurrent force system, parallel force system, distributed load - reduction.	9
W3	The discription of motion in terms of position vector, and in terms of path coordinates, velocity and acceleration vectors, tangential and centripetal acceleration, circular motion- angular velocity and acceleration compound motion of a particle, inertial and non-inertial reference frames, composition of velocity and acceleration in compound motion.	6
W4	Kinematics of a rigid body, distribution of velocities in a rigid body, methods of description of motion, special cases of motion : translation, rotation about a fixed point, rotation about a fixed axis, planar motion, center of instantenous rotation in planar motion.	6
W5	Equilibrium of forces and objects in equilibrium constraints - definition and classification, examples of constrained motion, virtual displacement, the principle of virtual work, derivation of the equations of equilibrium.	2
W6	Statics: supports, reactions at supports, idealized structures static determinacy and stability of the structure, determining reactions at supports and forces in the truss members for statically determinate structure by means of equations of equilibrium and the principle of virtual work.	4
W7	Dynamics of a particle: free motion, motion under smooth and non-smooth frictional constraints. Lagrange's equations of the first kind,. Free, dumped and forced vibrations of the systems with one degree of freedom, resonance,magnification factor. Dynamic equations in terms of path coordinates.	12
W8	Dynamics of rigid bodies and system of particles. Center of mass, center of gravity, centroid, statical moments. Linear and angular momentum. Euler's balance and conservation laws. Angular momentum in the rotational motion of the rigid body. Moments and products of inertia. Parallel axes theorem (Steiner's theorem). Basics of the tensor calculus, eigenvectors and eigenvalues of the symmetric moment of inertia tensor. Principal and principal centroidal moments and axes of inertia. Equations of motion of a rigid body.	14
W9	Selected problems of analytical mechanics. Work and energy, potential system of forces. Principle of work and energy. Decomposition of kinetic energy of the rigid body (Koenig's theorem). D'Alambert's principle, globalized coordinates, globalized forces. Lagrange's equations of the second kind. Analysis of the stability of equilibrium of the system.	6

Projekty		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
P1	Reduction of the spatial force system.	4
P2	Reduction of the planar and parallel force system.	4
P3	Kinematics of a particle, acceleration decomposition. Circural motion.	2
P4	Kinematics of a rigid body: distribution of velocities in planar motion, centers of instantenous rotation.	2
P5	Reactions at supports for simple beams and frames.	2
P6	Reactions at supports and forces in truss members for compound structures, by means of the equations of equilibrium and the principle of virtual work.	5
P7	Dynamics of a particle. Determination of motion of a particle by means of the different dynamic methods.	3
P8	The tensor of inertia for solids and planar figures. Statical moments, moments and products of inertia for the cross-section composite areas. Principal and principal centroidal moments and axes of inertia.	5
P9	Determination of motion and the stable equilibrium position of the systems by means of analytical mechanics.	3

7 Narzędzia dydaktyczne

N1 Wykłady

N2 Dyskusja

N3 Prezentacje multimedialne

N4 Ćwiczenia projektowe

N5 Konsultacje

N6 Zadania tablicowe

8 Obciążenie pracą studenta

Forma aktywności	Średnia liczba godzin na zrealizowanie aktywności
Godziny kontaktowe z nauczycielem akademickim, w tym:	
Godziny wynikające z planu studiów	0
Konsultacje przedmiotowe	6
Egzaminy i zaliczenia w sesji	10
Godziny bez udziału nauczyciela akademickiego wynikające z nakładu pracy studenta, w tym:	
Przygotowanie się do zajęć, w tym studiowanie zalecanej literatury	94
Opracowanie wyników	0
Przygotowanie raportu, projektu, prezentacji, dyskusji	70
Sumaryczna liczba godzin dla przedmiotu wynikająca z całego nakładu pracy studenta	**180**
Sumaryczna liczba punktów ECTS dla przedmiotu	9.00

9 Sposoby oceny

Ocena formująca

F1 Projekt indywidualny

F2 Test

F3 Kolokwium

Ocena podsumowująca

P1 Egzamin pisemny

P2 Średnia ważona ocen formujących

P3 Test

Warunki zaliczenia przedmiotu

W1 All projects must be approved, and all midterm tests must be passed in order to qualify for the final exam

W2 The written exam consists of two parts: test and numerical problems

Kryteria oceny

Efekt kształcenia 1	
Na ocenę 2.0	*

Na ocenę 3.0	A student understands the basic concepts of the theory of the equivalence of the systems of forces.
Na ocenę 3.5	*
Na ocenę 4.0	A student understands and explains the basic concepts of the theory of the equivalence of the systems of forces. He knows the theorems and can prove them.
Na ocenę 4.5	*
Na ocenę 5.0	A student understands and explains the basic concepts of the theory of the equivalence of the systems of forces. He knows the theorems and can prove them. He uses them to simplify the methods of solution of mechanics problems.
Efekt kształcenia 2	
Na ocenę 2.0	*
Na ocenę 3.0	A student can find the equivalent couple-force system at given point for both spatial and planar problems. He is able to reduce the parallel force system at the center of the system.
Na ocenę 3.5	*
Na ocenę 4.0	A student can find the equivalent couple-force system at given point, and find the simplest equivalent force system for both spatial and planar problems. He is able to reduce the parallel force system at the center of the system.
Na ocenę 4.5	*
Na ocenę 5.0	A student can find the equivalent couple-force system at given point, and find the simpest equivalent force system for both spatial and planar problems. He is able to reduce the parallel force system at the center of the system. He utilizes this concept in solution of static and dynamic problems of theoretical mechanics.
Efekt kształcenia 3	
Na ocenę 2.0	*
Na ocenę 3.0	A student knows and understands the basic quantities describing motion of a particle and rigid body.
Na ocenę 3.5	*
Na ocenę 4.0	A student knows and understands the basic quantities describing motion of a particle and rigid body, and can derive the relations between them. He is able to find the distribution of velocities in the rigid body (especially in planar motion).
Na ocenę 4.5	*
Na ocenę 5.0	A student knows and understands the basic quantities describing motion of a particle and rigid body and can derive the relations between them. He is able to find the distribution of velocities in the rigid body (especially in planar motion). He understands the kinematics of compound motion, and is ableto derive the velocity and acceleration in noninertial reference frames.

Efekt kształcenia 4	
Na ocenę 2.0	*
Na ocenę 3.0	A student can distinguish between statically determinate, indeterminate and unstable structures. He calculates the reactions at supports and forces in truss members for statically determinate structures using equations of equilibrium.
Na ocenę 3.5	*
Na ocenę 4.0	A student can distinguish between statically determinate, indeterminate and unstable structures, he can support the 2D structure to form the determinate system. He calculates the reactions at supports and forces in truss members for statically determinate structures using both equations of equilibrium and the principle of virtual work.
Na ocenę 4.5	*
Na ocenę 5.0	A student can distinguish between statically determinate, indeterminate and unstable structures, and is able to support the 2D structure to form the determinate system. He calculates the reactions at supports and forces in truss members for statically determinate structures using both equations of equilibrium and the principle of virtual work. He analysis the admissible velocity field for complex planar systems.
Efekt kształcenia 5	
Na ocenę 2.0	*
Na ocenę 3.0	A student describes the basic concepts of friction in civil engineering.
Na ocenę 3.5	*
Na ocenę 4.0	A student explaines the basic concept of friction and formulates the equations of motion for dry and viscous friction.
Na ocenę 4.5	*
Na ocenę 5.0	A student explaines the basic concept of friction with corresponding equations of motion for dry and viscous friction. He is able to solve these equations and critically analyze the solution.
Efekt kształcenia 6	
Na ocenę 2.0	*
Na ocenę 3.0	A student can analyze free, dumped and forced vibrations of the simple construction elements.
Na ocenę 3.5	*
Na ocenę 4.0	A student can analyze different kinds of vibrations with deriving corresponding differential equations of motion.
Na ocenę 4.5	*

Na ocenę 5.0	A student is able to analyze all kinds of vibrations of the simple construction elements. He describes the specific quantities (e.g. magnification factor, dumping ratio) introduced in the forced vibrations. He is also able to formulate the dynamic equations in terms of the path coordinate.
Efekt kształcenia 7	
Na ocenę 2.0	*
Na ocenę 3.0	A student knows und understands the laws of dynamics of rigid bodeis and systems of particles. He is able to determine the position of centroid and the principal centroidal moments and axes of inertia.
Na ocenę 3.5	*
Na ocenę 4.0	A student knows und understands the laws of dynamics of rigid bodeis and systems of particles. He can determine and analyze the tensor of inertia at any point, in particular at the centroid of the body.
Na ocenę 4.5	*
Na ocenę 5.0	A student knows und understands the laws of dynamics of rigid bodeis and systems of particles. He can determine and analyze the tensor of inertia at any point, in particular at the centroid of the body. He is able to formulate the differential equations for particular types of motion of a rigid body.
Efekt kształcenia 8	
Na ocenę 2.0	*
Na ocenę 3.0	A student is able to derive the differential equations of motion of a constrained particle and simple system of particles by means of one analytical methods of mechanics.
Na ocenę 3.5	*
Na ocenę 4.0	A student is able to derive the differential equations of motion of a constrained particle and simple system of particles by means of all analytical methods of mechanics.
Na ocenę 4.5	*
Na ocenę 5.0	A student is able to derive the differential equations of motion of a constrained particle and simple system of particles by means of all analytical methods of mechanics. He is able to analyze the stability of equilibrium of a material system.

10 Macierz realizacji przedmiotu

Efekt kształcenia	Odniesienie danego efektu do szczegółowych efektów zdefiniowanych dla programu	Cele przedmiotu	Treści programowe	Narzędzia dydaktyczne	Sposoby oceny
EK1	K_W01, K_W04, K_U02	Cel 1	w1 w2 p1 p2	N1 N2 N3 N4 N5	F3 P1 P3
EK2	K_W01, K_W04, K_U02	Cel 1	w2 p1 p2	N1 N2 N3 N4 N5 N6	F1 F3 P1 P2
EK3	K_W01, K_W04	Cel 2	w3 w4 p3 p4	N1 N2 N3 N4 N5 N6	F1 F2 F3 P1 P2 P3
EK4	K_W01, K_W04, K_W05, K_U04	Cel 3	w4 w5 w6 p4 p5 p6	N1 N2 N3 N4 N5 N6	F1 F2 F3 P1 P2 P3
EK5	K_W01, K_W04	Cel 4	w7	N1 N2 N3 N5 N6	F3 P2 P3
EK6	K_W01, K_W04, K_W05	Cel 5	w7 w8 w9 p7 p8	N1 N2 N3 N4 N5 N6	F1 F2 F3 P1 P2 P3
EK7	K_W01, K_W04, K_W05, K_U04, K_U10	Cel 5	w7 p7	N1 N2 N3 N4 N5 N6	F2 F3 P2 P3
EK8	K_W01, K_W04, K_W05	Cel 6	w9 p9	N1 N2 N3 N4 N5 N6	F1 F2 F3 P1 P2 P3

11 Wykaz literatury

Literatura podstawowa

[1] Bedford A., Fowler W. — *Engineering Mechanics*, Massachusetts, 1992, Addison-Wesley Publishin Company

[2] Plesha M., Gray G., Costanzo F. — *Engineering Mechanics*, New York, 2010, McGraw Hill

[3] Banach Stefan — *Mechanics*, Warszawa, 1951, http://banach.univ.gda.pl/mechanics.html

[4] Anil V. Rao — *Dynamics of Particles and Rigid Bodies*, Cambrigde, 2006, Cambridge University Press

[5] F, P..Beer, E. R. Johnston — *Vector Mechanics For Engineers .Statics, Dynamics.*, New York, 1988, McGraw Hill

Literatura uzupełniająca

[1] Marian Paluch — *Mechanika teoretyczna*, Kraków, 2000, Wydawnictwo PK

12 Informacje o nauczycielach akademickich

Osoba odpowiedzialna za kartę

prof. dr hab. inż. Leszek Mikulski (kontakt: ps@pk.edu.pl)

Osoby prowadzące przedmiot

1 Dr inż. Marian Mikołajek (kontakt: marianmikolajek@interia.pl)

2 Dr inż. Dorota Jasińska (kontakt: jasinska@limba.wil.pk.edu.pl)

13 Zatwierdzenie karty przedmiotu do realizacji

(miejscowość, data) (odpowiedzialny za przedmiot) (dziekan)

Przyjmuję do realizacji (data i podpisy osób prowadzących przedmiot)

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