MINISTRY OF EDUCATION AND SCIENCE
REPUBLIC OF KAZAKHSTAN

SATBAYEV UNIVERSITY

APPROVED BY

**Head of the Institute
Cybernetics and
Information Technology**

Seilova N.

**Head of the Department
Applied Mechanics and
Engineering Graphics**

Koltaev A.

«14» _August_ 2019 y.

SILLABUS

GEN1663 « Mechanical systems design »

3 (1/1/1) Credits

Semester: Autumn, 2019-2020 Academic year

For specialty 5B071200- Mechanical engineering

Almaty, 2019

Силлабус
Сатпаев Университет

Satpayev University
Institute of Cybernetics and Information Technology
Department of Applied Mechanics and Engineering Graphics

1. Information about teachers:

Lecturer
Naurushev B.K.
Office hours: Tue 15:25 – 16:15, room 905 MEB
Email: batyr_n@mail.ru

Teacher **(practical lessons)**	**Teacher** **(laboratory lessons)**
Naurushev B.K.	Naurushev B.K.
Office hours: Tue 15:30 – 17:20 room 905 MEB	Office hours: Tue 17:30 – 18:20, room 905 MEB
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2. **Course Objective:** training the future engineer in the basic methods of designing machine parts, mechanisms, structural elements and components used in the practice of mechanical engineering. Design techniques are taught during lectures, and practical exercises solve the problems of designing machine parts, mechanisms, structural elements and assemblies, in laboratory studies designing machine parts, mechanisms, structural elements and assemblies using the APM WinMachine computer program., preparing him for the correct choice of calculation and design methods, familiarizing himself with the latest achievements of science and technology in the field of mechanics, developing students' logical thinking, self- further work in the solution of certain problems of natural science and technology.

3. **Course Description:** Designing machine parts, mechanisms, structural elements and assemblies used in engineering practice both analytically and using the APM WinMachine computer program.

4. Prerequisites:
✓ Mathematics
✓ Theoretical mechanics
✓ Strength of materials

5. Post-requisitioning:
✓ Graduation work

6. References:

Basic Literature	**Additional literature**
[1] Шелофаст В.В. Основы проектирования машин. – М.: издат-во АПМ., 2015 – 472 с.	[4] Замрий А.А. Проектирование и расчет методом конечных элементов трехмерных конструкций в среде АРМ Structure 3D. – М.: Издательство АПМ. 2015. – 288 с.
[2] The Mechanical Systems Design Handbook, Osita D.I. N., Y. Hurmuzlu, CRC Press, 2017	[5] Кунву Ли. Основы САПР (CAD/CAM/CAE). – СПб.: Питер, 2014. – 560 с.
[3] Mechanical System Design, Simant, R. C. Mishra, PHI Learning Pvt. Ltd., 2009	[6] Шелофаст В.В., Чугунова Т.Б. Основы проектирования машин. Примеры решения задач. – М.: издат-во АПМ., 2015 – 240 с

7. Calendar - thematic plan:.

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week	Theme of the lecture	Theme of practical work	Theme of laboratory work	Reference to literature	The task	Deadline
1	Introduction Methods for calculating the stress-strain state of simple models. Basic concepts and definitions..	Build diagrams of longitudinal forces. Find the stresses for the elements of the construction.	APM Winmachine computer system interface. Tasks for calculating the core model of the design.	[1] Chapter 1, pp. 11-35	1в	4th week
2	Tensile (compression) of rod models. Geometric characteristics of cross sections.	Find the stress and calculate the strength for the structural elements.	Tasks for calculating the model of the structure of the rods.	[1] Chapter 2, pp. 36-53	Design of the rod structure (truss).	4th week
3	Shift and torsion. Torsion of round bars. Torsion bars of arbitrary shape. Torsion of a cylinder spring.	Tasks for the calculation of torsion structural elements.	Calculation of machine elements on APM Structure 3D for torsion.	[1] Chapter 2, pp. 54-67		
4	Bend. Internal power factors. Stress caused by individual bending. Oblique bend. Tangential stresses from transverse forces.	Tasks for the calculation of structural elements in bending.	Calculation of machine elements on APM Structure 3D for bending.	[1] Chapter 2, pp. 68-77	Oil Rack Design	8th week
5	Methods for calculating the deformed state of elastic systems. The stress state at the point. Limit theory strained states.	Tasks for determining the displacements of structural elements.	Calculation of machine elements on APM Structure 3D for displacement.	[1] Chapter 2, pp. 92-102		
6	Stability of mechanical structures. Strength calculation with a variable nature of external loading.	Tasks for determining the critical force and selection of sections of structural elements.	Cross-sectional selection of structural elements in APM Structure 3D.	[1], Chapter 2, pp. 111-136		
7	Engineering materials. Criteria for calculating machines, images and designs.	Tasks for the calculation of machines, mechanisms and structures.	Calculation of machines, mechanisms and structures using the	[1] Chapter 2, pages	Control work	7th week

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			APM STUDIO module.	137-151		
8	Engineering materials. Criteria for calculating machines, images and designs.	Tasks for the calculation of machines, mechanisms and structures.	Calculation of machines, mechanisms and structures using the APM STUDIO module.	[1] Chapter 2, pages 137-151		8th week
Midterm						
9	Detachable connections. Threaded connections. Compounds of parts during transmission of rotation. Connections with conical rings.	Tasks for calculating threaded joints, interference fit, conical connection.	Calculation of threaded connections, interference fit, conical connection using APM Joint.	[1] Chapter 4, pp. 204-239	Design bolted connection. Weld Design	10th week
10	Welded joints	Tasks for the calculation of welded joints.	Weld analysis using APM Joint.	[1] Chapter 4, pp. 256-275	Weld Design	12th week
11	Gears. Cylindrical gears.	Tasks for the calculation of cylindrical, helical, chevron gears.	Calculation of spur, helical, chevron gears using APM Trans.	[1] Chapter 6, pp. 282-317	Design gear transmission rotation.	12th week
12	Planetary and differential gears. Flexible communications. Belt drive. Chain gears.	Tasks for the calculation of bevel, worm, planetary, belt, chain gears.	Calculation of bevel, worm, planetary, belt, chain gears using APM Trans.	[1], Chapter 7.8, pp. 320-400		
13	General purpose parts. Shafts and axis.	Tasks for calculating machine shafts.	Shaft calculation on APM Shaft.	[1], Chapter 10, pp.401-407		
14	Elastic elements of machines. Plain bearings Rolling bearings.	Tasks for calculating machine rolling and sliding bearings.	Calculation of plain bearings on APM Plain. Calculation of rolling bearings on APM Bear.	[1], Chapter 10, pp. 408-415	Control work	14th week
15	Elastic elements of machines. Plain bearings Rolling bearings.	Tasks for calculating machine rolling and sliding bearings.	Calculation of plain bearings on APM Plain. Calculation of rolling bearings on APM Bear.	[1], Chapter 10, pp. 408-415		15th week
End Term						
Exam						

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The calendar - a thematic calendar is subject to change based on holidays

Schedule of delivery of required work

№ п/ п	Types of control	Max point of the week	Weeks															Total max points
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Activity in lecture discussions	0,1		*	*	*	*	*	*		*	*	*	*	*	*		1,2
2	Activity in practical classes	0,23		*	*	*	*	*	*		*	*	*	*	*	*		2,8
3	Laboratory works	5				*				*				*			*	20
3	Test papers	4							*							*		8
4	IWS	2				*				*				*			*	8
5	Midterm	10,0								*								10
6	Endterm	10,0															*	10
	Exam	40																40
	Total amount																	100

8. **Tasks and brief guidelines for their implementation:**

✓ **Independent work of the student (IWS):**
Semester task 1. Designing the structure of the rods (trusses).
Semester task 2. Design of the oil pump rack.
Semester task 3. Designing a bolted connection. Weld design.
Semester task 4. Design of gears transmission.
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✓ **Work with the teacher (WWT):**
Test work 1. Theme: Selection of the cross-section of structural elements operating in tension or bending.
Test work 2. Theme: Calculation of bolted, welded joints.

✓ **Practical work:**
Practical lesson №1 To plot the longitudinal forces. Find stresses for structural elements.
Practical lesson №2 Find stresses and calculate strength for structural elements.
Practical lesson №3 Tasks for calculating torsion structural elements.
Practical lesson №4 Tasks for calculating bending structural elements.
Practical lesson №5 Tasks for determining the movements of structural elements.
Practical lesson №6 Tasks for determining the critical force and selection of sections of structural elements.
Practical lesson №7 Tasks for the calculation of machines, mechanisms and structures.
Practical lesson №8 Tasks for the calculation of mechanisms structures.
Practical lesson №9 Tasks for calculating threaded connections, interference fit, conical connection.
Practical lesson №10 Tasks for calculating keyed pin spline, profile, terminal connections.
Practical lesson №11 Tasks for the calculation of rivet welded joints.
Practical lesson №12 Tasks for the calculation of cylindrical spur, helical, chevron gears.
Practical lesson №13 Tasks for the calculation of bevel, worm, planetary, belt, chain gears.
Practical lesson №14 Tasks for calculating machine shafts.
Practical lesson №15 Tasks for calculating machine rolling and sliding bearings.

✓ **Laboratory work:**

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Laboratory work №1 APM Winmachine computer system interface. Tasks for calculating the model of the structure of the rods.
Laboratory work №2 Tasks for calculating a model from structural rods.
Laboratory work №3 Calculation of machine elements on APM Structure 3D for torsion.
Laboratory work №4 Calculation of machine elements on APM Structure 3D for bending.
Laboratory work №5 Calculation of machine elements on APM Structure 3D for displacement.
Laboratory work №6 Cross-sectional selection of structural elements in APM Structure 3D.
Laboratory work №7 Calculation of machines, mechanisms and structures using AWP STUDIO.
Laboratory work №8 Calculation of threaded connections, interference fit, conical connection using APM Joint.
Laboratory work №9 Calculation of keyed spline, profile, terminal connections using APM Joint.
Laboratory work №10 Calculation of rivet welds using APM Joint.
Laboratory work №11 Calculation of spur, helical, chevron gears using APM Trans.
Laboratory work №12 Calculation of bevel, worm, planetary, belt, chain gears using APM Trans.
Laboratory work №13 Shaft calculation on APM Shaft.
Laboratory work №14 Calculation of plain bearings on APM Plain.
Laboratory work №15 Calculation of rolling bearings on the APM Bear.

✓ Midterm**:**
They represent an independent solution of tasks on the topics covered under the guidance of the teacher. Tasks will be presented during office hours. They are compulsory for all students, like the current independent work. When performing tests, you must use the knowledge obtained from textbooks and exercises.

✓ **Exam:**
The exam covers and summarizes the entire course material. The exam is conducted in writing and covers various types of assignments: theory questions, covering the lecture material covered, practical solution of specific problems. The duration of the exam is 2 academic hours.

9. Criteria for evaluation of works:

Evaluation by letter system	Digital equivalent of evaluation	Criterions
A	95 – 100	Correctness and completeness of answers and solving problems, accuracy and accuracy of presentation, calculation and timely delivery, presentability and communicative protection.
A -	90 – 94	Correctness and completeness of answers and problem solving. Timely delivery, presentable and communicative on protection.
B +	85 – 89	Correctness and completeness of answers and problem solving. Timely delivery, presentable and communicative on protection. But inaccurate in the design of work.
B	80 – 84	Correctness and completeness of answers and problem solving. Timely delivery, presentable and communicative on protection. But minor errors in mathematical calculations are allowed.
B -	75 – 79	Correctness and completeness of answers and problem solving.
C +	70 – 74	The work was completed in full. There are gaps in the theoretical material.

C	65 – 69	The work was completed in full. There are errors in the calculations, gaps in the theoretical material.
C -	60 – 64	The work was completed in full. There are errors in the calculations, gaps in the theoretical material. Ignorance of the methodology of the work. The answer is not given.
D +	55 – 59	The work was done in incomplete volume. Some correct necessary formulas or theoretical calculations or laws are given. A partial solution is given.
D	50 – 54	The work was done in incomplete volume. Some correct necessary formulas or theoretical calculations or laws are given. There is no complete solution.
F	0 – 49	Not done. Absence without good reason.

* It is possible to receive bonus points for additional tasks

10. Policy for late performance of works:

It requires timely and full implementation of all types of work. Tasks must be performed in writing and handed over as soon as the deadline is reached. Timeliness of performance and delivery of works will be taken into account. The reduction of the maximum score by 10% is envisaged for inactivated work. If you do not keep within the calendar deadlines for the delivery of work for valid reasons, you must notify the teacher in advance of the deadline for the submission of work.

11. Attendance Policy:

Visiting lecture, laboratory and practical classes is mandatory and is one of the components of your final score / evaluation. Skipping classes can affect your academic performance and final grade. Each two delays and / or departures before the end of the lesson for any reason will be considered as one *missed classes*. However, attending classes in itself does not mean an increase in scores. You need your constant active participation in the class. An obligatory requirement of the course is preparation for each lesson. It is necessary to review the indicated sections of the textbook and additional material not only in preparation for practical classes, but also before attending a relevant lecture. Such training will facilitate the perception of new material by you and will help your active acquisition of knowledge within the university. Students who missed 20% of classes are not allowed to take exams and receive a final rating of "F".

12. Assessment of knowledge:

7.11.1 Grade "F" is given to the student:
- in case of missing more than 20% of the total number of classroom activities in the discipline, with the exception of cases provided for in clause 7.11.3;
- if the student scored less than 25 points during the semester (0-24 points);
- in the event of the fact of non-independent performance of the final control (exam), including the use of prohibited means and other violations by the student of the Rules of conduct in the exam;
- in the event that the assessment of the final control (exam) is less than 10 points;
- in case of failure to appear for the exam without a good reason.
- if the student was unable to confirm the total threshold level of 50 or more points during the retake of the exam of FX assessment

7.11.2. The grade "FX" is given to the student if the student scored a total of at least 25 points during the semester, but could not confirm the total threshold level of 50 or more points in the exam.

7.11.3. The examiner has the right to admit to the exam a student who has more than 20%, but less than 30% of admissions in case of his positive certification and active work in the academic period, for which he must send a notice to the PR agreed with the department and the institute in the prescribed manner.

7.11.4 When the fact of non-independent performance of the final control or the presence of a student's cheat sheet, as well as in other cases, when a student violates the Rules of conduct in the exam (cheating, using electronic means of communication, etc.), the student is removed from the exam. At the same time, the student is given the final grade "F" in discipline, regardless of the

number of points scored by him during the semester

13. Policy of academic behavior and ethics:
Be tolerant, respect someone else's opinion. Objections formulate in the correct form. Plagiarism and other forms of dishonest work are unacceptable. It is unacceptable to hint and cheat during the exams, passing the exam for another student. A student who is found to falsify any course information will receive a final rating of "F".

Considered at a meeting of the department Applied Mechanics and Engineering Graphics, protocol №1, August 12, 2019

Compiled by: Lector   Naurushev B.