

Program: Engineering and Technologies

This document outlines the scope of themes, which may be included in the Olympiad tests. The themes are grouped by areas and are followed by the list of recommended references in the Russian and English languages.

Olympiad winner's skill set by Subject

Analytical activity.

Description

1. Analysis of mechanical systems. The ability to understand the nature of the movement of a mechanical system by its appearance, the nature of the loading of a structure according to its drawing
2. Analysis of electrical circuits. Understanding the structure of an electrical circuit from its image.
3. Reading drawings. The ability to understand the appearance of a part by looking at its drawing.
4. Analyzing system stability. To own methods of analyzing the system stability and dynamics performance.

Project-oriented activities.

Description

1. Execution of drawings. Ability to draw parts and assembly drawings of varying complexity.
2. Synthesis of automatic control systems. To own methods of synthesis of automatic control systems.

Research activities.

Description

1. Calculation of mechanical systems. The ability to calculate the parameters of movement of material points and parts of mechanisms, as well as loads in static structures.
2. Calculation of electrical circuits. Ability to calculate the parameters of electrical circuits and electronic devices.
3. Transformation of control systems models. To be able to perform the analysis of mathematical models of control systems and their transformation (including from one model form to another).

Content

Section 1. Theoretical mechanics

1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction.
2. Kinematics of a point; translational and rotational motion of a rigid body.
3. Velocity and acceleration at points of a rigid body and with complex motion.
4. Differential equations of motion of a material point.
5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.

Section 2. Engineering graphics

1. Basic concepts of descriptive geometry (coordinate system, rectangular projection, Monge plot, point, line, plane, higher order surfaces)
2. Projection drawing, axonometric projection;
3. Classification of drawings (part drawing, assembly drawing, general arrangement drawing, theoretical drawing, dimensional drawing, wiring drawing, assembly drawing, packing drawing, specification);
4. Execution of drawings.

Section 3. Strength of materials

1. Types of deformations: elastic and plastic deformation.
2. Strength, rigidity, structural stability.
3. External forces (loads) - classification. Internal forces.
4. The section method.
5. Articulated-movable bearing, articulated-fixed bearing, rigid termination.
6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending.
7. Geometric characteristics of flat sections.
8. The study of stress-strain state.
9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems.
10. Complex resistance.

Section 4. Automatic Control Theory

1. Differential equations, transfer functions and frequency response functions of linear continuous systems
2. Performance measures of linear system dynamics in time-, frequency- and root domains
3. Equivalent transformations of linear system block diagrams
4. Mathematical models of dynamic systems in the form of state variables
5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion)
6. Nyquist stability criterion
7. State feedback system design: Modal control (pole assignment)
8. System state reconstruction using state observers
9. Equilibrium states of linear and nonlinear systems. Lyapunov's first and second methods in motion stability analysis

Section 5. Electrical Engineering

1. Calculation of resistive R-circuits
2. Transient processes in linear circuits

3. Steady-state sinusoidal mode
4. Three-phase circuits.

Section 6. Electronics

1. Semiconductor devices.
2. Analog electronic devices.
3. Basics of digital technology.
4. Digital devices.

Recommended literature

Section 1. Theoretical mechanics

Sources	Corresponding topic
1. Hand L.N.; Finch J.D. (). Analytical Mechanics. Cambridge University Press, 1998. 576 p. https://www.amazon.com/Analytical-Mechanics-Louis-N-Hand/dp/0521575729 Access regime: limited	4. Differential equations of motion of a material point. 5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.
2. Kibble T. W.; Berkshire, F. H. (2004). Classical Mechanics. 5 th edition Imperial College Press. 2011. 478 p. https://www.amazon.com/Classical-Mechanics-5th-Tom-Kibble/dp/1860944353 Access regime: limited	4. Differential equations of motion of a material point. 5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.
3. Nimal Rajapakse, et al. Engineering Mechanics 1: Statics, Springer Berlin Heidelberg. 2009. 296 p. https://link.springer.com/book/10.1007/978-3-540-89937-2 Access regime: limited	1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction.
4. McLean W.G., et al. Engineering Mechanics, Statics and Dynamics, McGrawHill (1962). https://archive.org/details/schaumsoutlineof0000mc/le Access regime: limited	1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction. 2. Kinematics of a point; translational and rotational motion of a rigid body. 3. Velocity and acceleration at points of a rigid body and with complex motion. 4. Differential equations of motion of a material point.
5. Polyakhov N.N., Yushkov M.P., Zegzhda S.A. Rational and Applied Mechanics, Springer Cham. 2021. 520p https://link.springer.com/book/10.1007/978-3-030-64061-3 Access regime: limited	1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction. 2. Kinematics of a point; translational and rotational motion of a rigid body. 3. Velocity and acceleration at points of a rigid body and with complex motion.

	4. Differential equations of motion of a material point.
<p>6. Бать М.И и др. Теоретическая механика в примерах и задачах. Учеб. пособ. для вузов. В 2-х т./М.И.Бать, Г.Ю.Джанелидзе, А.С. Кельзон.-9-е изд., перераб. - М.: Наука, 2007.-670 с. https://lib-bkm.ru/load/114-1-0-2981 Access regime: free</p>	<p>1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction. 2. Kinematics of a point; translational and rotational motion of a rigid body. 3. Velocity and acceleration at points of a rigid body and with complex motion. 4. Differential equations of motion of a material point. 5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.</p>
<p>7. Бутенин Н.В. и др. Курс теоретической механики: Учеб.пособие для студ-ов вузов по техн. спец.:В 2-х т./Н.В.Бутенин, Я.Л.Лунц, Д.Р.Меркин. СПб.:Лань.-5-е изд., испр. 2008.-729 с. https://lib-bkm.ru/14968 Access regime: free</p>	<p>1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction. 2. Kinematics of a point; translational and rotational motion of a rigid body. 3. Velocity and acceleration at points of a rigid body and with complex motion. 4. Differential equations of motion of a material point. 5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.</p>
<p>8. Мещерский И.В. Задачи по теоретической механике: Учеб. пособие для студ. вузов, обуч. по техн. спец./И.В.Мещерский; Под ред.В.А.Пальмова,Д.Д.Меркина.-45-е изд., стер.-СПб. и др.: Лань, 2009.-447 с. 2. https://lib-bkm.ru/load/114-1-0-3053 Access regime: free</p>	<p>1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction. 2. Kinematics of a point; translational and rotational motion of a rigid body. 3. Velocity and acceleration at points of a rigid body and with complex motion. 4. Differential equations of motion of a material point. 5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.</p>
<p>9. Тарг С.М. Краткий курс теоретической механики: Учеб. для втузов/С.М.Тарг.-15-е изд., стер. - М.: Высш. шк., 2008.-415 с. https://bookree.org/reader?file=450338 Access regime: free</p>	<p>1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction. 2. Kinematics of a point; translational and rotational motion of a rigid body. 3. Velocity and acceleration at points of a rigid body and with complex motion.</p>

	<p>4. Differential equations of motion of a material point.</p> <p>5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.</p>
<p>10. Яблонский А.А., В.М.Никифорова Курс теоретической механики. Учеб.пособие для вузов: 13-е изд., исправ.-М.: Интеграл-Пресс,2009.-603с. https://www.cataloxy.ru/books/4122017_kurs-teoreticheskoy-mehaniki.htm Access regime: limited</p>	<p>1. Equilibrium of a rigid body under the conditions of a convergent, flat or spatial system of forces; friction.</p> <p>2. Kinematics of a point; translational and rotational motion of a rigid body.</p> <p>3. Velocity and acceleration at points of a rigid body and with complex motion.</p> <p>4. Differential equations of motion of a material point.</p> <p>5. General theorems of the dynamics of a material point and a mechanical system, applications to the dynamics of a rigid body.</p>

Section 2. Engineering graphics

Sources	Corresponding topic
<p>1. Descriptive Geometry Subsequent Edition by Robert Olin Loving (Author), Ivan Leroy Hill (Author), R. C. Pare (Author), E. G. Pare (Editor)Subsequent edition (November 30, 1996), English, 455 pages, https://www.amazon.com/Descriptive-Geometry-9th-G-Pare/dp/002391341X Access regime: limited</p>	<p>3. Classification of drawings (part drawing, assembly drawing, general arrangement drawing, theoretical drawing, dimensional drawing, wiring drawing, assembly drawing, packing drawing, specification);</p> <p>4. Execution of drawings.</p>
<p>2. Descriptive Geometry for Students of Engineering (Classic Reprint) Hardcover – February 11, 2019 https://www.amazon.com/Descriptive-Geometry-Students-Engineering-Classic/dp/0365452785 Access regime: limited</p>	<p>3. Classification of drawings (part drawing, assembly drawing, general arrangement drawing, theoretical drawing, dimensional drawing, wiring drawing, assembly drawing, packing drawing, specification);</p> <p>4. Execution of drawings.</p>
<p>3. Manual of Engineering Drawing : Technical Product Specification and Documentation to British and International Standards. Colin Simmons, Dennis Maguire. Elsevier Science & TechnologyOxford, United Kingdom, 01 Jul 2012 https://www.bookdepository.com/Manual-Engineering-Drawing-Colin-Simmons/9780080966526?ref=grid-view</p>	<p>3. Classification of drawings (part drawing, assembly drawing, general arrangement drawing, theoretical drawing, dimensional drawing, wiring drawing, assembly drawing, packing drawing, specification);</p> <p>4. Execution of drawings.</p>

Access regime: limited	
<p>4. Большаков В.П. Создание трехмерных моделей и конструкторской документации в системе КОМПАС-3D. Практикум. — СПб.: БХВ-Петербург, 2010. — 496 с.: ил. + DVD — (Учебное пособие)</p> <p>https://bhv.ru/product/sozdanie-trehmernih-modelej-i-konstruktorskoj-dokumentatsii-v-sisteme-kompas-3d-praktikum/</p> <p>Access regime: limited</p>	<p>1. Basic concepts of descriptive geometry (coordinate system, rectangular projection, Monge plot, point, line, plane, higher order surfaces)</p> <p>2. Projection drawing, axonometric projection;</p>
<p>5. Инженерная и компьютерная графика: электрон. учеб. - метод. пособие к практ. занятиям и самост. работе студентов/ Р. А. Сакаев, Ю. В. Павлова, Б. М. Перлов, А. И. Лысков — СПб. : Изд-во СПбГЭТУ "ЛЭТИ", 2017.</p> <p>http://library.etu.ru/jirbis2/index.php?option=com_irbis&view=irbis&Itemid=108&task=set_static_req&bl_id_string=1&req_irb=%3c.%3eI=%D0%96%2011/%D0%9B88-352808%3c.%3e</p> <p>Access regime: limited</p>	<p>1. Basic concepts of descriptive geometry (coordinate system, rectangular projection, Monge plot, point, line, plane, higher order surfaces)</p> <p>2. Projection drawing, axonometric projection;</p>
<p>6. Машиностроительное черчение, Справочник, Попова Г.Н., Алексеев С.Ю., 2011</p> <p>https://obuchalka.org/20180613101094/mashinostroitelnoe-cherchenie-spravochnik-popova-g-n-alekseev-s-u-2011.html</p> <p>Access regime: free</p>	<p>3. Classification of drawings (part drawing, assembly drawing, general arrangement drawing, theoretical drawing, dimensional drawing, wiring drawing, assembly drawing, packing drawing, specification);</p> <p>4. Execution of drawings.</p>
<p>7. Фролов С. А. Начертательная геометрия: учебник для ВТУЗов. — 2-е изд. — М.: Машиностроение, 1983. -240 с., ил.</p> <p>https://obuchalka.org/2017082195873/nachertatelna-ya-geometriya-frolov-s-a-2010.html</p> <p>Access regime: free</p>	<p>3. Classification of drawings (part drawing, assembly drawing, general arrangement drawing, theoretical drawing, dimensional drawing, wiring drawing, assembly drawing, packing drawing, specification);</p> <p>4. Execution of drawings.</p>

Section3. Strength of materials

Source	Corresponding topics
<p>1. Ashby, Michael; Hugh Shercliff; David Cebon (2007). Materials: engineering, science, processing and design (1st ed.). Butterworth-Heinemann.</p> <p>https://www.academia.edu/29966966/Materials_Engineering_Science_Processing_and_Design_pdf</p> <p>Access regime: free</p>	<p>9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems.</p> <p>10. Complex resistance.</p>

<p>2. Askeland, Donald R.; Pradeep P. Phulé (2005). The Science & Engineering of Materials (5th ed.). Thomson-Engineering. https://www.academia.edu/29796144/Solution_Manual_The_Science_and_Engineering_of_Materials_5th_Edition Access regime: limited</p>	<p>7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>
<p>3. Bansal R.K . By Dr.. Strength of Materials ч PDF Strength of Materials By Dr. R.K. Bansal PDF Download Strength of Materials https://instapdf-in.translate.google/strength-of-materials/?x_tr_sl=en&x_tr_tl=ru&x_tr_hl=ru&x_tr_pto=op,sc Access regime: free</p>	<p>1. Types of deformations: elastic and plastic deformation. 2. Strength, rigidity, structural stability. 3. External forces (loads) - classification. Internal forces. 4. The section method. 5. Articulated-movable bearing, articulated-fixed bearing, rigid termination. 6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending. 7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>
<p>4. TIMOSHENKO. S BY . STRENGTH OF MATERIALS. PART I. Elementary Theory and Problems.. Professor of Theoretical and Engineering Mechanics. Stanford University. 450 с. http://www.engineering108.com/Data/Engineering/Mechanical/SM/Strength_Of_Materials_parts_IandII-Timoshenko.pdf Access regime: free</p>	<p>1. Types of deformations: elastic and plastic deformation. 2. Strength, rigidity, structural stability. 3. External forces (loads) - classification. Internal forces. 4. The section method. 5. Articulated-movable bearing, articulated-fixed bearing, rigid termination. 6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending. 7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>
<p>5. Александров А.В. и др. в двух частях Соппротивление материалов: Учебник и практикум для вузов –9-е изд., испр. – Москва: издательство Юрайт, 2020. 1ч– 293 с. 2ч-273с. Высшее образование</p>	<p>1. Types of deformations: elastic and plastic deformation. 2. Strength, rigidity, structural stability. 3. External forces (loads) - classification. Internal forces. 4. The section method.</p>

<p>https://obuchalka.org/20210810135107/soprotivleni-e-materialov-chast-2-aleksandrov-a-v-potapov-v-d-derjavin-b-p-2020.html</p> <p>Access regime: free</p>	<p>5. Articulated-movable bearing, articulated-fixed bearing, rigid termination. 6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending. 7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>
<p>6. Бояршинов С.В. Основы строительной механики машин – М. : Машиностроение, 1973. – 456 с. https://lib-bkm.ru/load/114-1-0-1329</p> <p>Access regime: free</p>	<p>T6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending. 7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>
<p>7. Гафаров Р.Х. Что нужно знать о сопротивлении материалов: Учебное пособие для вузов обуч. по направлениям подгот. и спец. в области техники и технологии – М.: Машиностроение, 2009. – 275 с. https://obuchalka.org/20220225141604/chto-nujno-znat-o-soprotivlenii-materialov-uchebnoe-posobie-gafarov-r-x-jernakov-v-s-2001.html</p> <p>Access regime: free</p>	<p>1. Types of deformations: elastic and plastic deformation. 2. Strength, rigidity, structural stability. 3. External forces (loads) - classification. Internal forces. 4. The section method. 5. Articulated-movable bearing, articulated-fixed bearing, rigid termination. 6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending. 7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>
<p>8. Дарков А.В. Сопротивление материалов. – М. : Высшая школа, 2007. – 623 с. http://allformgsu.ru/load/sopromat/soprotivlenie_materialov_darkov_a_v_shpiro_g_s/26-1-0-163</p> <p>Access regime: free</p>	<p>1. Types of deformations: elastic and plastic deformation. 2. Strength, rigidity, structural stability. 3. External forces (loads) - classification. Internal forces. 4. The section method. 5. Articulated-movable bearing, articulated-fixed bearing, rigid termination.</p>

	<p>6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending.</p> <p>7. Geometric characteristics of flat sections.</p> <p>8. The study of stress-strain state.</p> <p>9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems.</p> <p>10. Complex resistance.</p>
<p>9. Миролюбов И.Н. и др. Пособие по решению задач по сопротивлению материалов : учебное пособие для технических вузов. – М. : Высшая школа, 2007. – 399 с. https://bookree.org/reader?file=438622 Access regime: free</p>	<p>1. Types of deformations: elastic and plastic deformation.</p> <p>2. Strength, rigidity, structural stability.</p> <p>3. External forces (loads) - classification. Internal forces.</p> <p>4. The section method.</p> <p>5. Articulated-movable bearing, articulated-fixed bearing, rigid termination.</p> <p>6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending.</p> <p>7. Geometric characteristics of flat sections.</p> <p>8. The study of stress-strain state.</p> <p>9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems.</p> <p>10. Complex resistance.</p>
<p>10. Степин П.А. Сопротивление материалов. – М. : Высшая школа, 2008. – 303 с. https://bookree.org/reader?file=470176 Access regime: free</p>	<p>1. Types of deformations: elastic and plastic deformation.</p> <p>2. Strength, rigidity, structural stability.</p> <p>3. External forces (loads) - classification. Internal forces.</p> <p>4. The section method.</p> <p>5. Articulated-movable bearing, articulated-fixed bearing, rigid termination.</p> <p>6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending.</p> <p>7. Geometric characteristics of flat sections.</p> <p>8. The study of stress-strain state.</p> <p>9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems.</p> <p>10. Complex resistance.</p>
<p>11. Сурьянинов Н.Г. Методы построения эпюр в статически определимых и статически неопределимых системах -- 2009, 155с.</p>	<p>1. Types of deformations: elastic and plastic deformation.</p> <p>2. Strength, rigidity, structural stability.</p>

<p>https://dwg.ru/dnl/2593 Access regime: free</p>	<p>3. External forces (loads) - classification. Internal forces. 4. The section method. 5. Articulated-movable bearing, articulated-fixed bearing, rigid termination. 6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending. 7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>
<p>12. Феодосьев В.И. Сопротивление материалов: Учебник для студ-ов высш.техн.учеб.зав. – 10-е изд., перераб. и доп. – М.: Изд-во МГТУ им. Н.Э. Баумана, 1999. – 592 с. https://pnu.edu.ru/media/filer_public/2013/04/10/2-12_fedosev_sopromat_1999.pdf Access regime: free</p>	<p>1. Types of deformations: elastic and plastic deformation. 2. Strength, rigidity, structural stability. 3. External forces (loads) - classification. Internal forces. 4. The section method. 5. Articulated-movable bearing, articulated-fixed bearing, rigid termination. 6. Calculations of the strength and stiffness of the rods under tension-compression, torsion, bending. 7. Geometric characteristics of flat sections. 8. The study of stress-strain state. 9. Displacements and deformations of statically determinable and statically indeterminate rods and rod systems. 10. Complex resistance.</p>

Section 4. Automatic Control Theory

Source	Corresponding topics
<p>1. Dorf R. C., Bishop R. H. Modern Control Systems. 10th edition. L.: Pearson Prentice Hall, 2005. https://powerunit-ju.com/wp-content/uploads/2016/11/Book-Modern_Control_Systems_11th_Edition.pdf Access regime: free</p>	<p>1. Differential equations, transfer functions and frequency response functions of linear continuous systems 2. Performance measures of linear system dynamics in time-, frequency- and root domains 4. Mathematical models of dynamic systems in the form of state variables 5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion) 6. Nyquist stability criterion</p>

<p>2. Gantmacher, Felix (1959), Theory of matrices, AMS Chelsea publishing https://pdfcoffee.com/the-theory-of-matrices-vol-2-gantmacher-pdf-pdf-free.html Access regime: free</p>	<p>5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion)</p>
<p>3. Hägglund T. Automatic Control. Lecture Notes. Lund, 2019. https://www.control.lth.se/fileadmin/control/Education/EngineeringProgram/FRTF05/engforel.pdf Access regime: free</p>	<p>7. State feedback system design: Modal control (pole assignment)</p>
<p>4. Khalil H. K. Nonlinear Systems. 3rd Edition. N. J.: Prentice Hall, 2002. https://www.lirmm.fr/~chemori/Temp/Ines/Khalil_Nonlinear_Systems.pdf Access regime: free</p>	<p>9. Equilibrium states of linear and nonlinear systems. Lyapunov's first and second methods in motion stability analysis</p>
<p>5. Kwakernaak H., Sivan R. Linear Optimal Control Systems. N. Y.: Wiley, 1972. https://yandex.ru/search/?text=kwakernaak+sivan&lr=2&clid=2296048&win=375&src=suggest_T Access regime: free</p>	<p>8. System state reconstruction using state observers</p>
<p>6. Wonham W. M. On Pole Assignment in Multivariable Linear Systems // IEEE Trans. on Automatic Control, Dec.1968, pp. 747–748. https://www.researchgate.net/publication/3025444_On_pole_assignment_in_multivariable_linear_systems/link/5488c9fa0cf268d28f08ff49/download Access regime: free</p>	<p>7. State feedback system design: Modal control (pole assignment)</p>
<p>7. Бесекерский В. А., Попов Е. П. Теория систем автоматического управления. М.: Профессия, 2003. https://booksee.org/book/635481 Access regime: free</p>	<p>1. Differential equations, transfer functions and frequency response functions of linear continuous systems 2. Performance measures of linear system dynamics in time-, frequency- and root domains 3. Equivalent transformations of linear system block diagrams 5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion) 6. Nyquist stability criterion</p>
<p>8. Бороденко В. А. Сборник задач по теории автоматического управления. Павлодар: Кереку, 2009. http://knigainformatika.com/rule/Borodenko_zadaniya_TAU.pdf Access regime: free</p>	<p>7. State feedback system design: Modal control (pole assignment) 8. System state reconstruction using state observers</p>
<p>9. Гантмахер Ф. Р. Теория матриц. — М.: Наука, 1967. https://booksee.org/book/569100</p>	<p>5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion)</p>

Access regime: free	
<p>10. Дорф Р., Бишоп Р. Современные системы управления. М.: Лаборатория Базовых Знаний, 2002. https://booksee.org/book/561484 Access regime: free</p>	<p>1. Differential equations, transfer functions and frequency response functions of linear continuous systems 2. Performance measures of linear system dynamics in time-, frequency- and root domains 4. Mathematical models of dynamic systems in the form of state variables 5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion) 6. Nyquist stability criterion</p>
<p>11. Квакернаак Х., Сиван Р. Линейные оптимальные системы управления. М.: Мир, 1977. https://booksee.org/book/445855 Access regime: free</p>	<p>8. System state reconstruction using state observers</p>
<p>12. Ким Д. П., Дмитриева Н. Д. Сборник задач по теории автоматического управления. Линейные системы. М.: ФИЗМАТЛИТ, 2007. https://eruditor.io/file/1035189/ Access regime: limited</p>	<p>1. Differential equations, transfer functions and frequency response functions of linear continuous systems 3. Equivalent transformations of linear system block diagrams 5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion)</p>
<p>13. Кузовков Н. Т. Модальное управление и наблюдающие устройства. М.: Машиностроение, 1976. https://booksee.org/book/532491 Access regime: free</p>	<p>4. Mathematical models of dynamic systems in the form of state variables 7. State feedback system design: Modal control (pole assignment) 8. System state reconstruction using state observers</p>
<p>14. Мирошник И. В. Теория автоматического управления. Линейные системы. СПб.: Питер, 2006. https://booksee.org/book/482940 Access regime: free</p>	<p>9. Equilibrium states of linear and nonlinear systems. Lyapunov's first and second methods in motion stability analysis</p>
<p>15. Сю Д., Мейер А. Современная теория автоматического управления и ее применение. М.: Машиностроение, 1972. https://booksee.org/book/544981 Access regime: free</p>	<p>4. Mathematical models of dynamic systems in the form of state variables 9. Equilibrium states of linear and nonlinear systems. Lyapunov's first and second methods in motion stability analysis</p>
<p>16. Филлипс Ч., Харбор Р. Системы управления с обратной связью. М.: Лаборатория Базовых Знаний, 2001. https://booksee.org/book/632886 Access regime: free</p>	<p>1. Differential equations, transfer functions and frequency response functions of linear continuous systems 2. Performance measures of linear system dynamics in time-, frequency- and root domains 4. Mathematical models of dynamic systems in the form of state variables</p>

	5. Routh-Hurwitz stability criterion (or Hurwitz stability criterion) 6. Nyquist stability criterion
17. Халил Х. К. Нелинейные системы. 3-е изд. М.–Ижевск: НИЦ «Регулярная и хаотическая динамика», Институт компьютерных исследований, 2009. https://ru.ug1lib.org/book/2524855/134f6a Access regime: free	9. Equilibrium states of linear and nonlinear systems. Lyapunov's first and second methods in motion stability analysis

Section 5. Electrical Engineering

Source	Corresponding topics
1. Charles K. Alexander, Matthew N.O. Sadiku Fundamentals of Electric Circuits. 5th edition. — McGraw-Hill, 2012. 992 p. https://eruditor.io/file/1863997/ Access regime: limited	1. Calculation of resistive R-circuits 2. Transient processes in linear circuits 3. Steady-state sinusoidal mode 4. Three-phase circuits.
2. Nilsson J.W., Riedel S. Electric Circuits. Peanon Prentice Hall, 2008. 855 p. https://eruditor.io/file/1101007/ Access regime: limited	1. Calculation of resistive R-circuits 2. Transient processes in linear circuits 3. Steady-state sinusoidal mode
3. Rizzoni Giorgio. Fundamentals of Electrical Engineering. New York: McGraw-Hill Education, 2009. 736 p. https://eruditor.io/file/1802751/ Access regime: limited	1. Calculation of resistive R-circuits 2. Transient processes in linear circuits 3. Steady-state sinusoidal mode
4. Wadhwa C.L. Basic Electrical Engineering. New Delhi, New Age International (P) Ltd., Publishers, 2007. 422 p. https://eruditor.io/file/1802694/ Access regime: limited	3. Steady-state sinusoidal mode 4. Three-phase circuits.
5. Аполлонский С.М., Виноградов А.Л. Теоретические основы электротехники. М.: КНОРУС, 2016. 250 с. https://pdf.11klasov.net/7223-teoreticheskie-osnovy-jelektrotehniki-alollonskij-sm-vinogradov-al.html Access regime: free	1. Calculation of resistive R-circuits 2. Transient processes in linear circuits 3. Steady-state sinusoidal mode 4. Three-phase circuits.
6. Атабеков Г. И. Теоретические основы электротехники. Линейные электрические цепи. СПб.: Издательство «Лань», 2009. 592 с. http://eor.dgu.ru/lectures_f/ЛабТОЭгиперссылки/учебники/26331_72f3adc944e19929b2ba15787d758c01.pdf	1. Calculation of resistive R-circuits 2. Transient processes in linear circuits 3. Steady-state sinusoidal mode

Access regime: free	
7. Бакалов В.П., Дмитриков В.Ф., Крук Б.Е. Основы теории цепей. М.: Радио и связь, 2000. 592 с. http://mts.edu.27.ru/biblio/OTC/31325_bakalov_v_p_osnovy_teorii_cepey_3_e_izdanie(2).pdf Access regime: free	1. Calculation of resistive R-circuits 3. Steady-state sinusoidal mode
8. Бессонов Л. А. Теоретические основы электротехники. Электрические цепи. М.: «Высшая школа», 1996. 638 с. http://publ.lib.ru/ARCHIVES/B/BESSONOV_Lev_Alekseevich/_Bessonov_L.A..html Access regime: free	1. Calculation of resistive R-circuits 3. Steady-state sinusoidal mode 4. Three-phase circuits.
9. Бычков Ю.А., Золотницкий В.М., Чернышев Э.П., Белянин А.Н. Основы теоретической электротехники. СПб.: Издательство «Лань», 2008. 592 с. http://group8209.ru/Books/TOE/Bychkov_uchebnik.pdf Access regime: free	1. Calculation of resistive R-circuits 3. Steady-state sinusoidal mode 4. Three-phase circuits.
10. Демирчян К.С., Нейман Л.Р., Коровкин Н.В. Теоретические основы электротехники. Том 1. – 4-е изд. СПб.: Питер, 2003. 463 с. https://www.elec.ru/viewer?url=/files/2020/01/30/nejman_teo_osn_eltex_t1.pdf Access regime: free	3. Steady-state sinusoidal mode 4. Three-phase circuits.
11. Иванов И.И., Соловьев Г.И., Фролов В.Я. Электротехника и основы электроники. СПб.: Издательство «Лань», 2021. 736 с. https://www.rulit.me/data/programs/resources/pdf/Ivanov_Elektrotehnika-i-osnovy-elektroniki_RuLit_Me_689668.pdf Access regime: free	1. Calculation of resistive R-circuits 2. Transient processes in linear circuits 3. Steady-state sinusoidal mode 4. Three-phase circuits.

Section 6. Electronics

Source	Corresponding topics
1. The Art of Electronics (3rd Edition) Paul Horowitz Winfield Hill Cambridge University Press 2015. Раздел заданий 1,2,3 https://artofelectronics.net Access regime: limited	1. Semiconductor devices. 2. Analog electronic devices. 3. Basics of digital technology.

<p>2. Low Level Measurements Handbook Precision DC Current, Voltage, and Resistance Measurements, SEVENTH EDITION, Copyright 2013 Keithley Instruments, Inc. https://assets.testequity.com/te1/Documents/pdf/keithley/KeithleyLowLevelHandbook_7Ed.pdf Access regime: free</p>	<ol style="list-style-type: none"> 1. Semiconductor devices. 2. Analog electronic devices. 3. Basics of digital technology. 4. Digital devices.
<p>3. Op Amps For Everyone. Ron Mancini, Editor in Chief. Design Reference. August 2002. Advanced Analog Products. https://web.mit.edu/6.101/www/reference/op_amps_everyone.pdf Access regime: free</p>	<ol style="list-style-type: none"> 2. Analog electronic devices. 3. Basics of digital technology. 4. Digital devices.
<p>4. Иванов, И.И. Электротехника и основы электроники: Учебник / И.И. Иванов, Г.И. Соловьев, В.Я. Фролов. - СПб.: Лань, 2016. - 736 с. https://www.rulit.me/data/programs/resources/pdf/Ivanov_Elektrotehnika-i-osnovy-elektroniki_RuLit_Me_689668.pdf Access regime: free</p>	<ol style="list-style-type: none"> 1. Semiconductor devices. 2. Analog electronic devices.
<p>5. Игумнов, Д.В. Основы полупроводниковой электроники: Учебное пособие для вузов / Д.В. Игумнов, Г.П. Костюнина. - М.: РиС, 2015. - 394 с. https://bookree.org/reader?file=736721 Access regime: free</p>	<ol style="list-style-type: none"> 1. Semiconductor devices. 2. Analog electronic devices.
<p>6. Манаев, Е.И. Основы радиоэлектроники / Е.И. Манаев. - М.: КД Либроком, 2019. - 512 с. https://www.elec.ru/library/nauchnaya-i-tehnicheskaya-literatura/manaev-osnovy-radioelektroniki/ Access regime: free</p>	<ol style="list-style-type: none"> 1. Semiconductor devices. 2. Analog electronic devices. 3. Basics of digital technology. 4. Digital devices.
<p>7. Марченко, А.Л. Основы электроники: Учебное пособие для ВУЗов / А.Л. Марченко. - М.: ДМК, 2016. - 294 с. https://www.litres.ru/aleksey-marchenko/osnovy-elektroniki-uchebnoe-posobie-dlya-vuzov Access regime: limited</p>	<ol style="list-style-type: none"> 1. Semiconductor devices. 2. Analog electronic devices. 3. Basics of digital technology. 4. Digital devices.

Recommended online courses

Section 1. Theoretical mechanics

1. Introduction to Engineering Mechanics (Coursera)
<https://coursera.org/learn/engineering-mechanics-statics>
2. Particle Dynamics (Coursera)
<https://www.coursera.org/learn/particle-dynamics>
3. Physics 101 - Rotational Motion and Gravitation (Coursera)
<https://www.coursera.org/learn/physics-101-rotational-motion-gravitation>
4. Rigid Body Dynamics (Coursera)
<https://www.coursera.org/learn/rigid-body-dynamics>

Section 2. Engineering graphics

1. How to Read Engineering Drawings – a Simple Guide (MakeUK)
<https://www.makeuk.org/insights/blogs/how-to-read-engineering-drawings-a-simple-guide>
2. Engineering Graphics/Drawing (MyGreatLearning)
<https://www.mygreatlearning.com/academy/learn-for-free/courses/engineering-graphics-drawing>
3. Engineering Graphics and Design (ClassCentral)
<https://www.classcentral.com/course/swayam-engineering-graphics-and-design-43589>
4. Nihar Ranjan Patra. Engineering Graphics. (ClassCentral)
<https://www.classcentral.com/course/swayam-engineering-graphics-5305>

Section 3. Strength of materials

1. Strength of Materials (FreeVideoLectures)
<https://freevideolectures.com/course/96/strength-of-materials>
2. Strength of Materials (FreeVideoLectures)
<https://freevideolectures.com/course/2361/strength-of-materials>
3. Mechanics of Materials I: Fundamentals of Stress & Strain and Axial Loading (Coursera)
<https://www.coursera.org/learn/mechanics-1>
4. Mechanics of Materials III: Beam Bending (Coursera)
<https://www.coursera.org/learn/beam-bending>
5. Mechanics of Materials IV: Deflections, Buckling, Combined Loading & Failure Theories (Coursera)
<https://www.coursera.org/learn/materials-structures>

Section 4. Automatic Control Theory

1. Classical Control Theory (Brian Douglas).
<https://www.youtube.com/playlist?list=PLUMWjy5jgHK1NC52DXXrriwihVrYZKqjk>
2. Principles of Automatic Control (MIT Open Courseware)
<https://ocw.mit.edu/courses/16-06-principles-of-automatic-control-fall-2012/pages/lecture-notes/>
3. Control Systems. (ClassCentral)
<https://www.classcentral.com/course/youtube-control-systems-48209/classroom>

Section 5. Electrical Engineering

1. CIRCUITS AND ELECTRONICS (MIT Open Courseware)
<https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/>
2. Introduction to circuit analysis (Udemy)
<https://www.udemy.com/course/full-course-circuit-analysis/>
3. Circuits and Electronics 1: Basic Circuit Analysis (EdX)
<https://www.edx.org/course/circuits-and-electronics-1-basic-circuit-analysi-2>
4. Linear Circuits 2: AC Analysis (Coursera)
<https://www.coursera.org/learn/linear-circuits-ac-analysis>
5. Basic Electrical Circuits (ClassCentral)
<https://www.classcentral.com/course/swayam-basic-electrical-circuits-618>

Section 6. Electronics

1. Basic Electronics For Beginners (YouTube)
<https://youtu.be/uXr4lXyjXuU>
2. Beginner Electronics (YouTube)
<https://youtube.com/playlist?list=PLah6faXAgguOeMUIxS22ZU4w5nDvCl5gs>
3. Introduction to Electronics (Coursera)
<https://www.coursera.org/learn/electronics>
4. Semiconductor Physics (Coursera)
<https://www.coursera.org/learn/semiconductor-physics>
5. Semiconductor Fundamentals (EdX)
<https://www.edx.org/course/semiconductor-fundamentals>