University of Isfahan

Course Outline
Railway Rolling Stock Engineering
Undergraduate Program

Department of Railway Engineering and Transportation Planning
Faculty of Civil Engineering and Transportation
University of Isfahan

Isfahan, Iran
www.ui.ac.ir

October 2024

1. Definition and goal

Railway rolling stock engineering undergraduate program is one of the higher education programs that its goal is training skilled experts for design, construction and management of railway engineering projects.

2. Duration of Program and the structure

The average duration of this program is 4 years. Every semester lasts 16 complete weeks of education. Each theoretical course takes 16 hours, each laboratory course might take 32 or 48 hours, and each workshop takes 48 hours each semester.

3. Credits

The total number of credits in this program is 140 that is described in Table 1. The titles of the aforementioned courses are as listed in Table 1 to 4.

Table 1. Course credits of Railway Rolling Stock Engineering Undergraduate Program

No.	Type of courses	Credits
1	General courses	22
2	Basic courses	22
3	Core courses	89
4	Optional courses	7
Total		140

Table 2. General courses for Railway Rolling Stock Engineering undergraduate program

Course No.	Course Title	Credits	Hours per week			Prerequisites/ Co-requisites
			Theoretical	Practical	Guided learning	
1	Islamic Thought 1	2	2	-	-	-
2	Islamic Thought 2	2	2	-	-	**1**
3	Islamic Ethics	2	2	-	-	
4	Islamic Revolution	2	2	-	-	
5	Islamic History	2	2	-	-	
6	Quran Studies	2	2	-	-	
7	Human Right in Islam	2	2	-	-	
8	General Literature	3	3	-	-	
9	General Foreign Language	3	3	-		
10	Physical Education 1	1	-	2	-	-
11	Physical Education 2	1	-	2	-	**10**
Total		22	20	4		

Table 3. Basic courses for Railway Rolling Stock Engineering undergraduate program

Course No.	Course Title	Credits	Hours per week			Prerequisites/ Co-requisites
			Theoretical	Practical	Guided learning	
12	General Mathematics I	3	3	-	1	**-**
13	General Mathematics II	3	3	-	1	**12**
14	Differential Equations	3	3	-	1	**13 (P/C)**
15	Computer Programming	3	3	-	1	**-**
16	Numerical Analyses	2	2	-	1	**14, 15 (P/C)**
17	Physics I: Mechanics and Heat	3	3	-	1	**12 (P/C)**
18	Physics I Laboratory	1	-	1	-	**17 (P/C)**
19	Physics II: Electromagnetics	3	3	-	1	**13 (P/C), 17**
20	Physics II Laboratory	1	-	1	-	**19 (P/C)**
Total		22	20	2	7	

Table 4. Core courses for Railway Rolling Stock Engineering undergraduate program

Course No.	Course Title	Credits	Hours per week			Prerequisites/ Co-requisites
			Theoretical	Practical	Guided learning	
21	Application of Chemistry for Railway	2	2	-	1	**-**
22	Fundamentals of Railway Substructure and Superstructure	2	2	-	1	**-**
23	Fundamentals of Communication and Signaling 1	2	2	-	1	**25 (P/C)**
24	Engineering Mathematics	3	3	-	1	**13, 14**
25	Fundamentals of Electrical Engineering	3	3	-	1	**19**
26	Fundamentals of Electrical Machines	3	3	-	1	**25**
27	Laboratory of Electrical Engineering	1	-	1	-	**26 (P/C)**
28	Industrial Graphices1	2	1	1	-	**-**
29	Statics	3	3	-	1	**12, 17**
30	Dynamics	3	3	-	1	**14 (P/C), 29**
31	Strength of Materials 1	3	3	-	1	**29**
32	Thermodynamics 1	3	3	-	1	**14 (P/C), 17**
33	Thermodynamics 2	3	3	-	1	**32**
34	Thermodynamics and Heat Transfer Laboratory	1	-	1	-	**32, 41**
35	Fluid Mechanics 1	3	3	-	1	**14, 30, 32(P/C)**
36	Fluid Mechanics laboratory	1	-	1	-	**35 (P/C)**
37	Machine Design 1	3	3	-	1	**30, 31**
38	Machine Design 2	3	3	-	1	**37**
39	Strength of Material 2	2	2	-	1	**31**
40	Strength of Material Laboratory	1	-	1	-	**39 (P/C)**
41	Heat Transfer 1	3	3	-	1	**32, 35**

42	Mechanical Vibration	3	3	-	1	**24, 30**
43	Dynamics & Vibration Laboratory	1	-	1	-	**42 (P/C)**
44	Automatic Control	3	3	-	1	**25, 35(P/C), 41(P/C), 42**
45	General Rules of Movement of Trains	2	2	-	1	**-**
46	Design of Wagon and Locomotive Structure	3	3	-	1	**29, 30, 42, 54(P/C)**
47	Railway Vehicle Dynamics	3	3	-	1	**30, 42**
48	Design of Train Brakes	2	2	-	1	**38**
49	Design of Railway Rolling Stock	2	2	-	1	**22, 30**
50	Technology of Construction and Repair of Railway Rolling Stock	3	2	1	1	**46**
51	Electric Railway	2	2	-	1	**23, 26**
52	Design of Bogie, Wheel and Axle	2	2	-	1	**38, 42, 46 (P/C)**
53	Locomotive Design	3	3	-	1	**26, 46**
54	Materials Science in Railway	3	3	-	1	**21**
55	Final project *	3	3			**At least 100 credits must be taken**
56	Welding & Plating Workshop	1	-	1	-	**-**
57	Machine Tools Workshop	1	-	1	-	**-**
58	Wagon and Brake Workshop	1	-	1	-	**46, 48**
59	Locomotive Workshop	1	-	1	-	**53**
60	Internship 1 **	-	-	-	-	**At least 80 credits must be taken**
61	Internship 2**					**60**
Total		89	78	11		

* Note: As part of Railway Rolling Stock Engineering's curriculum, all final year students are required to undertake a final project, supervised by one or two academic staff members of the Railway Engineering and Transportation Planning department.

** Note: As part of Railway Rolling Stock Engineering's curriculum, all students are required to undertake two internships after passing at least 80 credits. The purpose of taking the internships is to get practical skills and work experience in the railway industry.

In Table 5, the optional courses of The Railway Rolling Stock Engineering at the University of Isfahan are presented. Students should take 7 credits from the list of optional courses.

Table 5. Optional courses for Railway Rolling Stock Engineering undergraduate program

Course No.	Course Title	Credits	Hours per week			Prerequisites/ Co-requisites
			Theoretical	Practical	Guided learning	
62	Fundamental of Communication and Electrical Signs II	2	2	-	-	**23**
63	Fundamental of Subway Engineering	3	2	1	-	**-**
64	Internal Combustion Engine	3	3	-	-	**30, 32**
65	Introduction to Diesel Engines	2	2	-	-	**33**
66	Design for Manufacturing	3	3	-	-	**38, 44**
67	Technical English Writing	2	2	-	-	**9**
68	Practical Plasticity & Metal Forming	3	3	-	-	**38, 39**
69	Casting Workshop	1	-	1	-	**54 (P/C)**
70	Measurement Systems	2	2	-	-	**44**
71	Management and Rail Transport Economics	2	2	-	-	**At least 100 credits must be taken**
72	Wagon and Locomotive Installation	3	3	-	-	**46, 53**
73	Fundamentals of Electric Power Converters in Railway	3	3	-	1	**25, 26 (P/C)**

74	Hydraulic & Pneumatic	3	3	-	-	**32, 35, 44**
75	Maintenance and Repair of Wagons and Locomotives	3	2	1	-	**46, 48, 50**
76	Fundamental of Magnetic and High-Speed Trains	2	2	-	-	**26**
77	Fluid Mechanics 2	3	3	-	1	**35**
78	Heat Transfer 2	3	3	-	1	**41**
79	Bearings & Lubrication	3	3	-	1	**35, 38**
80	Dynamics of Machines	3	3	-	1	**30**
81	An introduction to business management and its application in railway	1	1	-	-	**After 6 Semesters**
82	Nanotechnology	1	1	-	-	
Total		51	48	3		

MATHEMATICS I

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Mathematics I, S1

Number of credits: 3

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Mathematical Sciences
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Introduction to mathematics including limits, derivatives, integrals, series, … Students are expected to:

- ✓ Learn the principals of mathematics for engineering courses
- ✓ Learn Integration Techniques
- ✓ Learn how to deal with functions and derivatives

REQUIRED STUDENT RESOURCES

Textbooks:

1. L. Leithold, “The Calculus with Analytic Geometry”, Vol. I, II, 5th Edition, Harper and Row Publisher, 1986.
2. R. A. Silverman, “Calculus with Analytic Geometry”, 4th Edition, Prentice Hall, 1984.
3. G. B. Thomas, “Elements of Calculus and Analytic Geometry”, Addison Wesley, 1981.
4. R. Larson, “Calculus with Analytic Geometry”, 7th Edition, 2002.

References:

1. G. B. Thomas, “Elements of Calculus and Analytic Geometry”, Addison Wesley, 1981.

Web links:

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Real numbers, Maximum, Minimum, infimum, Supremum
2	Series and the related Theorem
3	Series and the related Theorem
4	Functions and algebra of functions, limits
5	Function Continuity and theorems
6	Derivatives and its applications
7	Theorems of derivations
8	Logarithmic functions, inverse of a function, hyperbolic functions,
9	Trigonometric functions
10	Integrals and fundamentals of differentials,
11	Definite and indefinite integrals,
12	Integration Techniques, variable changes in integration
13	Integral applications, length of a curve, area, and volume
14	Series, power series,
15	Taylor's formula
16	Numerical methods

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignments	20 points
Mid-Term Exam	40 points
Final Exam	40 points
Total Points	100 points

ATTENDANCE STATEMENT

The course instructor must clearly inform students on the first day of class and in writing in the syllabus of their (1) policy regarding class absence and (2) policy, if any, for making up missed assignments. If class attendance is a component of the course grade, the course instructor must clearly communicate this to the class in writing in the syllabus.

STUDENTS WITH DISABILITIES ACT FOR STUDENTS WITH SPECIAL NEEDS STATEMENT

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concerns or requests with the instructor and contact the Disability Services Office as soon as possible."

APPROVED ACADEMIC HONESTY STATEMENT

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SYLLABI ON WEB PAGES

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MATHEMATICS II

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Mathematics II, S2

Number of credits: 3

COURSE PREREQUISITES:

Mathematics I

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Mathematical Sciences
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

This course provides complementary topics in continue of the course mathematics I. Students are expected to:

- ✓ Learn about the linear, planar and spatial equations
- ✓ Multi variable functions and its derivations
- ✓ Integral applications in engineering

REQUIRED STUDENT RESOURCES

Textbooks:

1. L. Leithold, “The Calculus with Analytic Geometry”, Vol. I, II, 5th Edition, Harper and Row Publisher, 1986.
2. R. A. Silverman, “Calculus with Analytic Geometry”, 4th Edition, Prentice Hall, 1984.
3. R. Larson, “Calculus with Analytic Geometry”, 7th Edition, 2002.

References:

1. R. A. Silverman, “Calculus with Analytic Geometry”, 4th Edition, Prentice Hall, 1984.

Web links: -

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Linear algebra, vector, Matrices, and linear equations
2	Gauss–Jordan Method, Reduced Row Echelon Form
3	vector spaces, Spaces and Subspaces, independency
4	Matrix Algebra
5	Analytic Geometry, equations of lines, plane, curve
6	Cartesian, polar and cylindrical coordinates
7	Multi variables functions, Gradient, Jacobian,
8	Directional derivatives
9	Space curves, Surfaces
10	Quadrics
11	Multiple integrations, Moment of inertias
12	Pappus’ Theorem
13	Improper integrals
14	Change of variables in multiple integrals
15	Laplace, Curl, Divergence and Green theorem,
16	Integral Applications

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignments	20 points
Mid-Term Exam	40 points
Final Exam	40 points
Total Points	100 points

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SYLLABI ON WEB PAGES

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DIFFERENTIAL EQUATIONS

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Differential Equations, S2

Number of credits: 3

COURSE PREREQUISITES:

Mathematics I

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Mathematical Sciences
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn how to solve various types of linear differential equations.
- ✓ Get familiar with applications of differential equations in physics and mechanics.

REQUIRED STUDENT RESOURCES

Textbooks:

1. W. E. Boyce, R. C. DiPrima, Elementary Differential Equations, 10th Edition, Wiley, 2012.

References:

1. C. H. Edwards, D. E. Penney, Elementary Differential Equations with Boundary Value Problems, 6th Edition, Prentice Hall, 2007.

2. W. E. Kohler, L. W. Johnson, Elementary Differential Equations with Boundary Value Problems, 2nd Edition, Addison Wesley, 2005.

Web links: -

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction to differential equations
2	Nature of differential equations and their solution
3	The family of curves and orthogonal paths
4	Physical patterns
5	Separable equations
6	Linear differential equation
7	First order linear differential equations
8	Homogeneous equations
9	Second order linear differential equations
10	Method of undetermined coefficients
11	Method of variation of parameters
12	Applications of second-order equations in physics and mechanics
13	Solving differential equations using series
14	Bessel and Gamma functions, Legendre polynomials
15	Introduction to systems of differential equations
16	Laplace transform and its applications in differential equations

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignment “A”	10 points
Assignment “B”	10 points
Assignment “C”	10 points
Assignment “D”	10 points
Mid-Term Exam	140 points
Final Exam	220 points
Total Points	400 points

ATTENDANCE STATEMENT

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COMPUTER PROGRAMMING

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Computer Programming, S3

Number of credits: 3

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Computer Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	-	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Understand the role of computations in Problem-Solving.
- ✓ Learn about the application of computer programming in mechanical and mechatronic systems.
- ✓ Design a computer program using a graphical user interface
- ✓ Develop a mobile application which can be used as a controller of a mechatronic system.

REQUIRED STUDENT RESOURCES

Textbooks:

1- M. Vine,''C Programming for the Absolute Beginner'', Course Technology PTR, 2002.
2- S. Kochan, ''Programming in C'', 3rd Edition, Sams, 2004.
3- P. Deitel, “Java How to Program”, 11th Edition, Sams, 2016.

References:

1- J. Stephen, “MATLAB Programming for Engineers”, 4rd Edition, Sams, 2009.

Web links:

Computer Software: Matlab, Eclipse, C++Builder, Visual Studio.net

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction to Computers and Programming Languages
2	Algorithm and Flowcharts; Data structures
3	Structural Programming and functions
4	Main Structures of Programming: Loops and Conditions
5	Introduction to Object Oriented Programming
6	Arrays and Matrices
7	Midterm
8	Graphical User Interface
9	Introduction to GUI design for a mobile application
10	Basic Concepts of Android Programming
11	Advanced Algorithms: Sort and Search
12	Recursive Functions
13	Programming with Integrated development environments: eclipse
14	Matlab Programming
15	Introduction to Matlab toolboxes
16	Advanced features of Matlab

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignments	40 points
Comprehensive Assignment	40 points
Mid-Term Exam	80 points
Project	100 points
Final Exam	140 points
Total Points	400 points

ATTENDANCE STATEMENT

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assignments. If class attendance is a component of the course grade, the course instructor must clearly communicate this to the class in writing in the syllabus.

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NUMERICAL ANALYSES

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Numerical Analyses, S4

Number of credits: 3

COURSE PREREQUISITES:

Differential Equations

COURSE CO-REQUISITES:

Computer Programming

TEACHERS:

Person in charge: Department of Mathematical Sciences
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Be able to apply the numerical methods for differentiation, nonlinear equations, and simultaneous linear equations
- ✓ Understand different concepts of Fourier expansions, the speed of convergence and numerical analysis;
- ✓ Design a numerical computing algorithm and implement it using programming languages
- ✓ Be able to calculate errors and implement their relationship to the accuracy of the numerical solutions

REQUIRED STUDENT RESOURCES

Textbooks:

1- D. V. Griffiths, and I. M. Smith, "Numerical Methods for Engineers", Oxford, England, UK: Blackwell Scientific Publications, 1991. (This book contains many FORTRAN examples.)

2- J. H. Ferziger, ''Numerical Methods for Engineering Application'', John Wiley, 1998.

References:

1- C. Gerald, P. Wheatley, ''Applied Numerical Analysis'', Addison Wesley Longman, 1999.
2- R. H. Pennington, ''Computer Methods and Numerical Analysis'', Macmillan, 2000.

Web links:

Computer Software: Matlab

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction to numerical analysis
2	Series expansions: from calculus to computation
3	Integrals as sums and derivatives as differences
4	Interpolation,
5	splines, and a second look at numerical calculus
6	Numerical methods for ODE, initial-value problems
7	Midterm
8	Root finding, Newton's method, boundary-value problems
9	Fourier transform, Fourier series
10	Bandlimited interpolation, spectral methods
11	Least-squares approximation
12	Function approximation using curve fitting and neural networks
13	Numerical Integration band differentiation
14	Advanced methods for Numerical differentiation
15	Linear equation systems
16	Advanced methods for the solution of Linear equation systems

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignments	40 points
Comprehensive Assignment	40 points
Mid-Term Exam	80 points
Project	40 points
Final Exam	100 points
Total Points	300 points

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PHYSICS I: MECHANICS AND HEAT

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Physics I: Mechanics and Heat, S1

Number of credits: 3

COURSE PREREQUISITES:

Mathematics I

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Faculty of Physics
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ provide students with a thorough understanding of the basic concepts of physics and the methods scientists use to explore natural phenomena
- ✓ Instruct students of the fundamental laws of physics and the application of scientific data, concepts, and models for use in the natural sciences and real-world situations.
- ✓ Provide students with Problem-Solving skills through an approach that describes physical phenomena with relevant mathematical models and formulae.
- ✓ Develop the student's mathematical ability to manipulate formulae and derive correct numerical solutions that can be measured in the real world.

REQUIRED STUDENT RESOURCES

Textbooks:

1- Halliday D., Resnick R., Walker J., Fundamentals of physics. 9th Edition, John Wiley & Sons: 2011. 1330 p.

References:

1- Cutnell J.D., Johnson K.W., Young D., Stadler S., Physics. 10th Edition, John Wiley & Sons: 2014. 992 p.
2- Bueche F.J., Hecht E., Schaum's Outline of College Physics, 11th Edition, McGraw-Hill, 2011.

Web links: -

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Measurement and scale
2	Motion, Position and Displacement, Average Velocity and Average Speed, Acceleration
3	Air processes using hot and cold air systems
4	Vectors and Scalars, Components of Vectors, Vectors and the Laws of Physics
5	Position and Displacement, Average Velocity and Instantaneous Velocity, Average Acceleration and Instantaneous Acceleration
6	Projectile Motion, Projectile Motion Analyzed, Relative Motion in One Dimension and Two Dimensions
7	Newton's First Law, Newton's Second Law, Newton's Third Law
8	Friction, The Drag Force and Terminal Speed, Uniform Circular Motion
9	Kinetic Energy, Work and Kinetic Energy, Work Done by a Spring Force, Work Done by a General Variable Force
10	Work and Potential Energy, Path Independence of Conservative Forces, Conservation of Mechanical Energy
11	Linear Momentum, The Linear Momentum of a System of Particles, Collision and Impulse, Elastic Collisions in One Dimension
12	Newton's Law of Gravitation, Gravitation and the Principle of Superposition
13	Density and Pressure of Fluids, Measuring Pressure, Pascal's Principle, Ideal Fluids in Motion
14	Temperature, The Zeroth Law of Thermodynamics, The Celsius and Fahrenheit Scales, Thermal Expansion
15	The First Law of Thermodynamics, Heat Transfer Mechanisms
16	Ideal Gases, Pressure, Temperature, and RMS Speed, The Molar Specific Heats of an Ideal Gas

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignment "A"	10 points
Assignment "B"	10 points
Assignment "C"	10 points
Assignment "D"	10 points
Mid-Term Exam I	60 points
Mid-Term Exam II	60 points
Final Exam	140 points
Total Points	300 points

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

Syllabi presented on web pages shall contain the date of last update.

PHYSICS II: ELECTROMAGNETICS

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Physics II: Electromagnetics, S2

Number of credits: 3

COURSE PREREQUISITES:

Physics I

COURSE CO-REQUISITES:

Mathematics II

TEACHERS:

Person in charge: Faculty of Physics
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to be able to:

- ✓ To describe, in words, how various concepts in electromagnetism come into play in particular situations;
- ✓ To represent these electromagnetic phenomena and fields mathematically in those situations;
- ✓ To predict outcomes in other similar situations.

REQUIRED STUDENT RESOURCES

Textbooks:

1- Halliday D., Resnick R., Walker J., Fundamentals of physics. 9th Edition, John Wiley & Sons: 2011. 1330 p.

References:

1- Serway R.A., Jewett J.R., Principles of Physics. 4th Edition, Brooks Cole: 2003.
2- Bueche F.J., Hecht E., Schaum's Outline of College Physics, 11th Edition, McGraw-Hill, 2011.

Web links: -

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Electric Charge, Conductors and Insulators, Coulomb's Law
2	The Electric Field, The Electric Field Due to a Point Charge, The Electric Field Due to a Line of Charge, A Point Charge in an Electric Field
3	The flux of an Electric Field, Gauss' Law and Coulomb's Law, A Charged Isolated Conductor
4	Electric Potential Energy, Calculating the Potential from the Field, Potential Due to a Point Charge
5	Potential Due to a Group of Point Charges, Potential Due to an Electric Dipole, Calculating the Field from the Potential, Potential of a Charged Isolated Conductor
6	Calculating the Capacitance, Energy Stored in an Electric Field, Dielectrics and Gauss' Law
7	Electric Current, Current Density, Resistance and Resistivity, Ohm's Law, Power in Electric Circuits
8	Work, Energy, and Emf, Calculating the Current in a Single-Loop Circuit, Potential Difference Between Two Points
9	Magnetic Field, The Hall Effect, A Circulating Charged Particle, Magnetic Force on a Current-Carrying Wire
10	Calculating the Magnetic Field Due to a Current, Ampere's Law
11	Solenoids and Toroids, A Current-Carrying Coil as a Magnetic Dipole
12	Faraday's Law of Induction, Induced Electric Fields, Inductors, and Inductance
13	Self-Induction, Energy Stored in a Magnetic Field, Energy Density of a Magnetic Field
14	Gauss' Law for Magnetic Fields, Induced Magnetic Fields
15	Displacement Current, Maxwell's Equations
16	Diamagnetism, Paramagnetism, Ferromagnetism

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignment "A"	10 points
Assignment "B"	10 points
Assignment "C"	10 points
Assignment "D"	10 points
Mid-Term Exam I	60 points
Mid-Term Exam II	60 points
Final Exam	140 points
Total Points	300 points

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SYLLABI ON WEB PAGES

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PHYSICS LABORATORY I

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Physics laboratory I, S2

Number of credits: 1

COURSE PREREQUISITES:

Physics I

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Faculty of Physics
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ Perform experiments to learn Newton's laws and thermodynamic laws.
- ✓ Design experiments.
- ✓ Get familiar with physical measurement equipment.
- ✓ Analyze data and make conclusions.

REQUIRED STUDENT RESOURCES

Textbooks:

1- Halliday D., Resnick R., Walker J., Fundamentals of physics. 9th Edition, John Wiley & Sons: 2011. 1330 p.

References:

1- Cutnell J.D., Johnson K.W., Young D., Stadler S., Physics. 10th Edition, John Wiley & Sons: 2014. 992 p.
2- Bueche F.J., Hecht E., Schaum's Outline of College Physics, 11th Edition, McGraw-Hill, 2011.

Web links: -

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Measurement test and calculate errors.
2	Motion test in one dimension and one plane.
3	Particle dynamics experiment.
4	Work and energy conservation experiment.
5	Rotational kinematic and dynamic experiment.
6	Impact test.
7	Measurement of temperature and heat and study the zero, 1st and 2nd laws of thermodynamics.

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Lab report 1	5 points
Lab report 2	5 points
Lab report 3	5 points
Lab report 4	5 points
Lab report 5	5 points
Lab report 6	5 points
Lab report 7	5 points
Attendance at the laboratory	15 points
Final Exam	50 points
Total Points	100 points

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SYLLABI ON WEB PAGES

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PHYSICS LABORATORY II

BASIC INFORMATION

Place in Curriculum, title and semester: Basic, Physics laboratory II, S3

Number of credits: 1

COURSE PREREQUISITES:

Physics II

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Faculty of Physics
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ Be familiar with electrical measurement tools and techniques.
- ✓ Perform some practical test in the field electrical circuits.
- ✓ Calculate the linear coefficients and their errors.
- ✓ Learn how to prepare a scientific report.

REQUIRED STUDENT RESOURCES

Lab manuals, calculators, ruler, and such measuring and drawing tools.

Textbooks:

1- Physics Laboratory II Agenda. The University of Isfahan.

References:

1- D. Halliday, R. Resnick, and J. Walker, "Fundamentals of Physics", 6th Edition, John Wiley & Sons, 2005.
2- A. Raymond, and A. Serway, "Principles of Physics", 4th Edition, Saunders College, 1997.
3- J. Cutnell and K. Johnson, ''Physics'', John Wiley, Sons, 7th Edition, 2006.

Web links: -

Computer Software: Matlab

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	The galvanometer introduction and its conversion to ammeter, voltmeter and ohmmeter.
2	Measurement of resistance.
3	The resistance of wires and the influence of wire length and cross-section area on it.
4	Measurement of capacitances and investigation of their laws.
5	Oscilloscope introduction and its applications.
6	Oscilloscope introduction and its applications.
7	Transformers.
8	Transformers.
9	Investigation of Kerchief's laws.
10	Investigation of Kerchief's laws.
11	Measurement of inductance and impedance (RC and RL circuits).
12	Measurement of inductance and impedance (RC and RL circuits).
13	RLC circuits.
14	RLC circuits.
15	Wheatstone bridge.
16	Calvin bridge.

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Reports	80 points
In-lab activities	20 points
Attendance	20 points
Final Exam	80 points
Total Points	200 points

ATTENDANCE STATEMENT

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assignments. If class attendance is a component of the course grade, the course instructor must clearly communicate this to the class in writing in the syllabus.

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SYLLABI ON WEB PAGES

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APPLICATION OF CHEMISTRY IN RAILWAY

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Applied Application of Chemistry in Railway for Railway, S1

Number of credits: 2

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Faculty of Chemistry
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

This course is an introduction to chemistry for railway engineering students. The specific aim of this course is as follows:

- ✓ Overview of chemistry history and its importance to daily life
- ✓ Classifying matter; its physical and chemical properties, significant figures in calculations; dimensional analysis
- ✓ Atomic theory, the structure of an atom, atomic and mass number, Periodic Table, elements, ions and molecular compounds, applying Avogadro's number and moles in calculations, percent composition of compounds, determine and define empirical and molecular formulas;
- ✓ Defining general properties of aqueous solutions; distinguishing between strong, weak, and non-electrolytes; categorizing soluble and insoluble ionic compounds; acids, bases, and neutralization reactions; writing molecular, ionic, and net ionic reactions for precipitation and acid-base reactions;
- ✓ Defining the general properties of gases; ideal gas laws; gas reaction stoichiometry, Dalton's Law of Partial Pressures;
- ✓ Quantum theory as related to the structure of atoms, waves, the dual nature of an electron, and energy, Bohr’s model of an atom versus the quantum mechanical model,

Schrodinger equation; quantum numbers for atomic orbitals and electrons, shapes of atomic orbitals and electron configurations for all atoms in the Periodic Table;

- ✓ Constructing Lewis dot symbols and formulas for elements, ions, and simple and complex molecules; distinguishing between ionic and covalent species and describe the properties of each; applying electronegativity to bond polarity; the difference between electronegativity and electron affinity, Valence Shell Electron-Pair Repulsion;
- ✓ Intermolecular forces in liquids and solids and types of intermolecular forces that exist in pure substances and mixtures; kinetic molecular theory of liquids and solids, role of intermolecular forces on properties, including boiling and melting points, surface tension, viscosity, and crystal structure; crystalline and amorphous solids and their properties; calculations of density and size of basic cubic compounds; X-ray diffraction;

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. Silberberg, M. S., "Principles of General Chemistry", 3rd Edition, McGraw-Hill, New York, 2012.
2. Petrucci, R. H., Herring, F. G., Madura, J. D, and Bissonnette, C., "General Chemistry: Principles and Modern Applications", 11th Edition, Pearson, Toronto, 2016.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	History and wisdom of knowledge in chemistry, Initial definitions, basic quantities, units, SI units, Conversion, Measurement, Uncertainty, Accuracy and Significant Figures, Rounding; Thermometers and temperatures of Celsius, Fahrenheit and Kelvin;
2	Component of matter, Elements, compositions, mixtures, mass conservation, fixed components of a compound and certain ratios; The Atomic Theory, Cathodic Beams, Electrons and Proton; The Thomson Atomic Theory and the New Atomic Theory; The electron, proton, neutron, atomic number, mass number, atomic symbols, isotopes, Periodic Table; Avogadro Number and Mole, Atomic Weight, Average Atomic Weight, Molecules, ions; Types of chemical formulas, the naming of ionic and binary covalent compounds;
3	Stoichiometry and its application in chemical calculations;

	Empirical formula, molecular formula, formula and molecular weights, molecule and mole; Calculations of chemical formula and methods for obtaining empirical and molecular formulas;
4	Equations and computations of chemical reactions, limiting reactant, reaction efficiency percentage; Molar and molar solutions, mass fractions, volumes and molar fractions; Calculations of solutions and calculations of chemical reactions in solutions;
5	Types of chemical reactions, equilibrium of reactions; The role of water (polar solvent) in chemical reactions (ionic, sedimentary, acid and alkaline and combustion); Acid-Base reactions, oxidation-reduction reactions, oxidation number; The balance of reactions using methods of changing the number of oxides, ion-electrons and elemental balances;
6	Matter states (solids, liquids and gases), gas pressure and its measurement; The Gas Laws and Their Experimental Foundations, Boyle-Mario's Law, Charles's Law, Avogadro rules, the general rule of gases; Ideal Gas Law, Mixture of Ideal Gases (Dalton and Amagat rules); Real gases, a molecular image of the behavior of gases (inter-molecular forces and collisions), Kinetic theory - molecular gases
7	Quantum Theory and Atomic Structure; Electromagnetic radiation, the Wave-Particle Duality of Matter and Energy; The absorption spectrum and atomic emission and Bohr theory; Wave Nature of Electrons and Particle, Nature of Photons, Heisenberg Uncertainty Principle; The Atomic Orbital, Quantum Numbers, Shapes of Atomic Orbitals;
8	Mid-Term
9	Electron Configuration and Chemical Periodicity; Development of the Periodic Table, Characteristics of Many-Electron Atoms, The Electron-Spin Quantum Number; The Quantum-Mechanical Model and the Periodic Table; Electron Configurations Within Groups, The First d-Orbital Transition Series; General Principles of Electron Configurations, Unusual Configurations: Transition and Inner Transition Elements;
10	Models of Chemical Bonding; Atomic Properties and Chemical Bonds, The Three Types of Chemical Bonding; Lewis Electron-Dot Symbols: Depicting Atoms in Chemical Bonding, The Ionic Bonding Model, Energy Considerations in Ionic Bonding: The Importance of Lattice Energy, Periodic Trends in Lattice Energy;
11	The Covalent Bonding Model, The Formation of a Covalent Bond, Properties of a Covalent Bond: Bond Energy and Bond Length, How the Model Explains the Properties of Covalent Substances; Bond Energy and Chemical Change, Changes in Bond Strength: Where does heat of reaction Come From, Using Bond Energies to Calculate the enthalpy of reactions; Between the Extremes: Electronegativity and Bond Polarity, Electronegativity, Polar Covalent Bonds and Bond Polarity, The Partial Ionic Character of Polar Covalent Bonds;
12	The shape of Molecules, Depicting Molecules and Ions with Lewis Structures, Using the Octet Rule to Write Lewis Structures, Resonance: Delocalized Electron-Pair Bonding, Formal Charge: Selecting the Most Important Resonance Structure, Lewis Structures for Exceptions to the Octet Rule;
13	Valence Bond (VB) Theory and Orbital Hybridization, The Central Themes of VB Theory, Types of Hybrid Orbitals;

	The Mode of Orbital Overlap and the Types of Covalent Bonds, Orbital Overlap in Single and Multiple Bonds, Mode of Overlap and Molecular Properties; Molecular Orbital (MO) Theory and Electron Delocalization, The Central Themes of MO Theory, Homonuclear Diatomic Molecules of the Period 2 Elements
14	Types of Intermolecular Forces, Ion-Dipole Forces, Dipole-Dipole Forces, The Hydrogen Bond, Polarizability and Charge-Induced Dipole Forces, Dispersion (London) Forces; Properties of the Liquid State, Surface Tension, Capillarity, Viscosity;
15	The Solid State: Structure, Properties, and Bonding, Structural Features of Solids, Types and Properties of Crystalline Solids, Bonding in Solids Free Convection from Spheres, Free Convection in Enclosed Spaces, Combined Free and Forced Convection;
16	Final

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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FUNDAMENTALS OF RAILWAY SUBSTRUCTURE AND SUPERSTRUCTURE

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fundamentals of Railway Substructure and Superstructure, S1

Number of credits: 2

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Dr. Ahmad Reza Jafarian-Moghaddam
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +983137935318
Email Address: ar.jafarian@trn.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

This course aims to familiarize students with the fundamentals of the railway infrastructure and superstructure, machinery, and permissible tolerances in railways line components.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1- J. S. Mundrey, Railway Track Engineering, McGraw-Hill, 2010
2- Alias J., LeRAll, Eyrolies, Paris, 1987
3- William W. Hay, Railroad Engineering Second Ed., John Wiley & Sons, New York, 1982

Web links: -

Computer Software: Microsoft Office package

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Railway infrastructure and technical buildings (bridges, tunnels, retaining walls, transverse type profiles)
2	Railway superstructure, ballast, and their tasks and specifications
3	Sleepers, and their tasks and specifications
4	Rails, and their tasks and specifications
5	Rail force (vertical, transverse, longitudinal)
6	Rail joints, joint bars connect rails
7	Supported, staggered, and suspended rail joints
8	Welded joints, welded rail joints
9	General faults in welded joints
10	Emergency joint bars and straps, safety strap, rail connectors
11	Rail fastening systems
12	Turnouts, crossovers, and diamond crossings
13	Switches and crossings, and their types
14	Common failures in switches
15	Overview of line maintenance
16	Introduction to railway line maintenance machinery (ballast cleaning, tamping, switch tamper, stabilizer, …)

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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FUNDAMENTALS OF COMMUNICATION AND SIGNALING 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fundamentals of Communication and Signaling 1, S3

Number of credits: 2

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

Fundamentals of Electrical Engineering

TEACHERS:

Person in charge: Dr. Pegah Hamedani
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37934262
Email Address: p.hamedani@eng.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to become familiar with the following topics:

- ✓ Different types of railway signals
- ✓ Interlocking
- ✓ Fixed block signaling systems and their design
- ✓ Train detection systems (track circuits and axle-counters)

REQUIRED STUDENT RESOURCES

References:

1. J. Pachl, Railway Control and Operation, 4th Edition, VTD Rail Publishing, 2018.
2. O. S. Nock, Railway Signaling, Institute of Railway Signal Engineering, A & C Black, 1997.
3. B. Ning, Advanced Train Control Systems, WIT Press, 2010.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction of signaling and communication systems in railway
2	History and developments of railway signals
3	Basics of fixed block signaling system in railways
4	Introduction of different signal types in railway and their application (semaphore, light signals, …)
5	Drawing the single line diagram of different fixed block signaling (2-aspect, 3-aspect, 4-aspect and 5-aspect blocks)
6	Methods of calculating Service Braking Distance in railway lines, calculating average gradient of line
7	Example of calculating the Service Braking Distance for a real line and its considerations
8	Headway and capacity definitions and their affecting parameters
9	Calculation of headway and capacity for different fixed block signaling
10	Examples of designing signaling systems for some railway lines
11	Introduction of fail-safe, redundancy, and fault tolerance concepts
12	Train detection systems (track circuits, axle-counter, …)
13	All types of track circuits (DC, AC, impulse, and audio frequency): Structure, working principles, and design considerations
14	Structure and working principles of point machines
15	Introduction to interlocking (history, basics, and applications)
16	All types of Railway Traffic Control Centers

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (10%), Project (0%), Midterm (40%), Final (50%)

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SYLLABI ON WEB PAGES

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ENGINEERING MATHEMATICS

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Engineering Mathematics, S4

Number of credits: 3

COURSE PREREQUISITES:

General Mathematics II, Differential Equations

COURSE CO-REQUISITES:

-

TEACHERS:

The person in charge: Faculty of Mathematics and Statistics
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	-	-	1 h

COURSE OBJECTIVES

The purpose of this course is the study of the main applications of mathematics in mechanical engineering, including the Fourier series, the solution of partial differential equations and complex numbers. Students are expected to:

- ✓ Understand the concepts of basic issues in Fourier series and Fourier integral.
- ✓ Solve Partial Differential Equations Using Fourier Series and Fourier Integral.
- ✓ Learn the basic concepts of complex numbers and complex functions.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. E. Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. J.W., Brawn, R., Churchill, "Complex Variables and its Applications", McGraw-Hill, 1996.
3. C. R. Wylie, L. C. Barret, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill, 1995.

Web links:

Web links: https://www.maplesoft.com/

Computer Software: MAPLE

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Definition of Fourier series, Euler's formula, Fourier series in the half-range expansions, forced oscillations.
2	Definition of Fourier series, Euler's formula, Fourier series in the half-range expansions, forced oscillations.
3	Definition of Fourier series, Euler's formula, Fourier series in the half-range expansions, forced oscillations.
4	Fourier integral.
5	Fourier integral.
6	Introduction to Partial Differential Equations
7	Vibrating string, one-dimensional wave equation
8	Variable separating method, D'Alembert's Solution of the wave equation. characteristics
9	Heat equation, steady two-dimensional heat problems, Laplacian in cartesian, spherical and polar, Analytic functions, Conformal Mapping and complex integrations: Limits and continuity, derivatives of complex functions, exponential, trigonometric and hyperbolic and logarithm functions, inverse trigonometric and exponential with complex exponent coordinates Sturm Liouville's theory and its applications, equations elliptic, hyperbolic.
10	Solution of partial differential equations by Laplace transforms, solving partial differential equations using Fourier integral.
11	Introduction to Complex number and complex function
12	Study of analytic functions, Conformal Mapping, and complex integrations: Limits and continuity, derivatives of complex functions, exponential, trigonometric and hyperbolic and logarithm functions, inverse trigonometric and exponential with a complex exponent
13	Learning of Mobius transformations, line integral in the complex plane, Gauss's integral theorem
14	Taylor and Maclaurin series
15	Residue integration method, residue theorem,
16	Residue integration of real integral.

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

Syllabi presented on web pages shall contain the date of last update.

FUNDAMENTALS OF ELECTRICAL ENGINEERING

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fundamentals of Electrical Engineering, S4

Number of credits: 3

COURSE PREREQUISITES:

Physics II

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Dr. Pegah Hamedani
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37934262
Email Address: p.hamedani@eng.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to become familiar with the following topics:

- ✓ Passive and active elements in electrical circuits
- ✓ Analyzing methods of electric circuits
- ✓ Single-phase and three-phase AC power systems

REQUIRED STUDENT RESOURCES

References:

1. L. O. Chua, Ch. A. Desoer, E. S. Kuh, Linear & Nonlinear Circuits, McGraw-Hill, 1987.
2. W. Hayt J. Kemmerly, J. Phillips, and S. Durbin, Engineering Circuit Analysis, McGraw-Hill, 9th Edition, 2019.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction of electric circuits, KVL law, KCL law, and Tellegen theorem
2	Introduction of passive elements used in linear circuits (resistors, inductors, capacitors, voltage sources, and current sources)
3	Different types of electric waveforms and basic functions
4	Series and parallel connections of the elements
5	Star to Delta & Delta to Star Conversion, Method of symmetry in solving electric circuits
6	Solving electric circuits using nodal analysis
7	Solving electric circuits using mesh analysis
8	Solving electric circuits using optimal analysis
9	Thevenin and Norton theorem, Superposition theorem
10	First order circuits (RL and RC)
11	Analyzing AC circuits with Phasor analysis
12	Introduction of three-phase circuits
13	Calculation of Active, Reactive, and Apparent powers in AC circuits and Power Factor definition
14	Average and effective values in various circuits
15	Introduction of semiconductors (Diodes and Transistors)
16	Basics of electrical safety

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (10%), Project (0%), Midterm (40%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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FUNDAMENTALS OF ELECTRICAL MACHINES

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fundamentals of Electrical Machines, S5

Number of credits: 3

COURSE PREREQUISITES:

Fundamentals of Electrical Engineering

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Dr. Pegah Hamedani
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37934262
Email Address: p.hamedani@eng.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to become familiar with the following topics:

- ✓ Analyzing Magnetic circuits
- ✓ Structure and working principles of DC machines
- ✓ Structure and working principles of transformers
- ✓ Structure and working principles of induction machines

REQUIRED STUDENT RESOURCES

References:

1. P. C. Sen, Principles of Electric Machines and Power Electronics, 3rd Edition, Wiley, 2013
2. S. J. Chapman, Electric Machinery Fundamentals, New York: McGraw-Hill, 2012.
3. A. E. Fitzerald, C. Kingsley, and S. D. Umans, Electric Machinery, 7th Edition. New York: McGraw-Hill, 2022.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Magnetics and electromagnetics
2	Calculations of magnetic forces
3	Analyzing magnetic circuits
4	Structure and working principles of DC machines
5	Types of DC motors with separate, series, shunt, and compound excitations
6	Equivalent circuit, torque-speed characteristics, and problem solving of different DC motor types
7	Losses and efficiency in DC motors
8	DC generators
9	Structure and working principles of transformers
10	Auto-transformers
11	Three-phase transformer connections
12	Structure and working principles of induction machines
13	Equivalent circuit and torque-speed characteristics of induction machines
14	Starting methods, losses and efficiency of induction motors
15	Problem solving of induction motors
16	Typical electric machine types for traction applications

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (10%), Project (0%), Midterm (40%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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LABORATORY OF ELECTRICAL ENGINEERING

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Laboratory of Electrical Engineering, S6

Number of credits: 1

COURSE PREREQUISITES:

Fundamentals of Electrical Machines

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Dr. Pegah Hamedani
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37934262
Email Address: p.hamedani@eng.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to become familiar with the following topics:

- ✓ Electrical circuits and measuring instruments
- ✓ Working principles of DC motors and generators
- ✓ Working principles of transformers
- ✓ Working principles of induction machines
- ✓ Working principles of AC generators

REQUIRED STUDENT RESOURCES

References:

1. P. C. Sen, Principles of Electric Machines and Power Electronics, 3rd Edition, Wiley, 2013
2. S. J. Chapman, Electric Machinery Fundamentals, New York: McGraw-Hill, 2012.
3. A. E. Fitzerald, C. Kingsley, and S. D. Umans, Electric Machinery, 7th Edition. New York: McGraw-Hill, 2022.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction to electric circuit elements, how to work with electrical devices and measuring instruments including oscilloscope, …
2	Response of first-order RL and RC circuits to sinusoidal input
3	Response of first- and second-order circuits to step input
4	Working principles of DC machines
5	Characteristics of different DC motors types (separate, series, shunt, and compound excitations)
6	Starting of DC motors
7	Losses and efficiency in DC motors
8	DC generators
9	Working principle of transformers
10	Three-phase transformer connections
11	Open-circuit and short-circuit tests on transformers
12	Working principle of induction machines
13	Characteristics of induction machines
14	Starting methods, Losses and efficiency in induction motors
15	No-load and blocked-rotor tests on three phase induction motor
16	AC generators

EVALUATION PROCEDURES AND GRADING CRITERIA

Reports (50%), Project (0%), Midterm (0%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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INDUSTRIAL GRAPHICS 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Industrial Graphics 1, S1

Number of credits: 2

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

The person in charge:
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
1 h	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn basic concepts about industrial drawing.
- ✓ Draw three principal views of objects.
- ✓ Draw perspective of objects by two views.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. Garin P. A. Outlines of Industrial Drawing: Grammar Course. Free Hand and Instrumental. Ulan Press; 2012.
2. Willson M. Drawing Guide; Manual of Instruction in Industrial Drawing, Designed to Accompany Industrial Drawing Series. University of California Libraries; 2008.
3. Bertolini G.R. Fundamentals of Graphics Communications. 6th Edition. McGraw-Hill; 2010.

Web links: -

Computer Software: AUTOCAD

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	An introduction to the industrial drawing and its applications
2	Projection of point, line, plane, and object on a plane
3	Introduction of three principal views of objects
4	The standard size of drawing papers
5	The draw of three principal views of objects
6	The draw of the third view of objects by two principal views
7	Introduction of six views of objects
8	The draw of the perspective of objects
9	Types of normal perspective such as Isometric, Dimetric, and trimetric
10	Types of oblique perspective such as cavalier and cabinet
11	Draw symmetric and asymmetric section of objects
12	Types of sections such as half section, local section, and radial section
13	Exceptions of section
14	Draw connectors such as bolt, nut, rivet, and weld
15	An introduction to the AutoCAD software
16	Draw simple shapes by the AutoCAD software

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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STATICS

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Statics, S2

Number of credits: 3

COURSE PREREQUISITES:

General Mathematics I, Physics I

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Familiarize students with different elements used in railway engineering mechanisms and familiarity with how to analyze bodies in equilibrium in two or three dimensions.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. J. L. Meriam and L.G. Kraige, Engineering Mechanics – Statics, 4th Edition, John Wiley and Sons, 2011.
2. R.G. Hibbeler, Engineering Mechanics–Statics, 13th Edition, Pearson Prentice Hall, 2010.
3. F. Beer, E. Johnston, and D. Mazurek, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Hill US Higher Ed., 2019.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	An overview of quantities, vector algebra, newton's laws, system of units
2	evaluating the resultant of the forces, equilibrium laws, moment about a point and moment about axis
3	cross and dot product of vectors, couple, the resultant of a system of forces, evaluating equivalent force
4	Parallel force system, general force system, Rigid bodies equilibrium equations, evaluating supporting forces, static equilibrium conditions, statically indeterminate and constraints
5	Structures: trusses, two-force members, Method of joints and Method of sections, frames and machines
6	Structures: trusses, two-force members, Method of joints and Method of sections, frames and machines
7	Distributed forces: the mass center and the centroids center of a composite bodies and figures
8	Distributed forces: the mass center and the centroids center of a composite bodies and figures
9	Beams: evaluating internal forces, shear-force and bearing-moment diagrams
10	Relationships between shear force and bending moment and distributed load
11	Cables: under concentrated lateral loads, distributed loads (parabolic and catenary)
12	Area moments and products of inertia: Integration method, parallel axes transfer theorem, composite area
13	Friction: Dry friction laws, friction angle, wedge, screws, bearings, disks, rolling, belt
14	Friction: Dry friction laws, friction angle, wedge, screws, bearings, disks, rolling, belt
15	Virtual work and energy method: work of a force, virtual displacements, virtual displacements
16	The main Application of virtual work in machines, potential energy, stability in equilibrium position

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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DYNAMICS

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Dynamics, S3

Number of credits: 3

COURSE PREREQUISITES:

Statics

COURSE CO-REQUISITES:

Differential Equations

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Familiarity of students with methods of analyzing moving bodies in two or three dimensions.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics – Dynamics, 4th Edition, John Wiley and Sons, 2012.
2. R. G. Hibbeler, Engineering Mechanics–Dynamics, 12 th Edition, Pearson Prentice Hall, 2010.
3. F. Beer, E. Johnston, and D. Mazurek, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Hill US Higher Ed., 2019.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Dynamic of particles: Introduction and definitions of dynamics, vectors, matrices, newton's laws
2	Kinematics of particles: Definition of motion, rectilinear motion of particles, angular motion
3	Plane curvilinear motion, plane relative motion, space curvilinear motion, space relative motion
4	Kinetics of particles: Introduction, equations of motion, work and energy
5	Impulse and momentum, central-force motion,
6	Kinetics of systems of particles: Introduction, equations of motion, work and energy
7	Linear momentum and angular momentum, conservation of energy and momentum
8	Linear momentum and angular momentum, conservation of energy and momentum
9	Dynamics of rigid bodies
10	Plane kinematics of rigid bodies: Introduction, absolute motion, relative motion with axes translating and relative motion with axes rotation
11	Plane kinematics of rigid bodies: Introduction, absolute motion, relative motion with axes translating and relative motion with axes rotation
12	Plane kinetics of rigid bodies: Mass moments of inertia about an axis, mass and acceleration, work and energy, impulse and momentum
13	Plane kinetics of rigid bodies: Mass moments of inertia about an axis, mass and acceleration, work and energy, impulse and momentum
14	Space kinematics of rigid bodies: absolute motion and relative motion
15	Space kinetics of rigid body: Angular momentum, mass moment of inertia
16	Momentum and energy equations of motion, general plane motion, rotation about a point, general space motion

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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STRENGTH OF MATERIALS 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Strength of Materials 1, S3

Number of credits: 3

COURSE PREREQUISITES:

Statics

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Understand the concept of stress and strain and the types of them.
- ✓ Analyze a given problem to calculate its internal stresses.
- ✓ Identify the types of loading and stresses and strains caused by each one.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. Popov E. Engineering Mechanics of Solids. 6th edition. Prentice-Hall; 2006.
2. Beer F., Johnson E., DeWolf J., Mazurek D. Mechanics of Materials. 7th edition. McGraw-Hill; 2014.
3. Hibbeler R. Mechanics of Materials. 7th edition. Prentice-Hall; 2007.
4. Gere J., Goodno B. Mechanics of Materials. 7th edition. CL-Engineering; 2008.

Web links: -

Computer Software: Ansys, Abaqus

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	The concept of stress, the definition of stress, types of stress, the tensor of stress, normal and shearing stresses, stress in connections
2	Stress on an oblique plane, stress under general loading conditions, components of stress, the factor of safety
3	Definition of strain, normal strain, stress-strain diagram, true stress and true strain
4	Hooke's law, modulus of elasticity, elastic versus plastic behavior of a material, statically indeterminate problems
5	a problem involving temperature changes, Poisson's ratio, generalized Hooke's law
6	bulk modulus, shearing strain, plastic deformations, residual stresses
7	The concept of torsion, stresses and deformations in a circular shaft, angle of twist in the elastic range, statically indeterminate shaft
8	Stress concentrations in the circular shaft, plastic deformation, shafts made of an elastoplastic material, residual stresses
9	Torsion of noncircular members, thin-walled hollow shafts
10	Symmetric member in pure bending, stresses and deformations in the elastic range, bending of members made of several materials
11	Beams made of an elastoplastic material, residual stresses, axial loading in a plane of symmetry
12	Unsymmetrical bending, the general case of eccentric axial loading, bending of curved members, Load, shear, and bending moment in a beam and their relationships
13	Using singularity functions to determine shear and bending moment in a beam
14	Shearing stresses in a beam, shearing stresses in thin-walled members
15	Shear center, Loading combination
16	The concept of stress, the definition of stress, types of stress, the tensor of stress, normal and shearing stresses, stress in connections

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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THERMODYNAMICS 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Thermodynamics 1, S3

Number of credits: 3

COURSE PREREQUISITES:

Physics I

COURSE CO-REQUISITES:

Differential Equations

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

The main goal of this course is to study the thermodynamic properties of pure substances and thermodynamic laws. Students are expected to:

- ✓ Cover the basic principles of thermodynamics
- ✓ Obtain an intuitive understanding of thermodynamics by emphasizing the physics.
- ✓ Apply the first and second law of thermodynamics on different systems.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. R. E. Sonntag, C. Borgnakke, V. Wylen, Fundamentals of Thermodynamics, 10th Ed., Wiley, 2019.
2- K. Wark, Thermodynamics, 5th Ed., McGraw-Hill, New York, 1988.
3- G. V. Whylen, R. Sountag, Fundamental of Classical Thermodynamics, Wiley, 4th Ed., 1993.
4- M. J. Moran, H. N. Shapiro, Fundamentals of Engineering Thermodynamics, Wiley, 8th Ed., 2014.

Web links: -

Computer Software: EES

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	**Definitions:** • thermodynamics and its literature, • thermodynamic closed and open systems (control volume), • state and properties of a pure substance, • process and cycle definition, • the zeroth law of thermodynamics • Temperature scales.
2	**Properties of pure substance:** • Phase diagrams, • State postulate, • Equilibrium of triple phases (vapor, liquid, solid), • Gas versus vapor, • Equations of state, • Ideal and real gases, • Thermodynamic Tables.
3	**Heat and work:** • definition of work and heat, • different types of works, • displacement of a boundary of a simple compressible system in a pseudo equilibrium process.
4	• solve some problems on heat and work.
5	**The first law of thermodynamics (closed systems):** • internal energy, • specific heat of solids and liquids • internal energy changes • the pseudo-equilibrium isobaric process • mass conservation law
6	• the first law for a process in a closed system • solve problems • empathy: a combination property • thermodynamic processes and cycles,
7	• supplementary notes • solve problems
8	**The first law of thermodynamics (open systems):** • mass conservation law, • the first law for an open system,

	• enthalpy, • supplementary notes and problems
9	• Specific heat at constant volume and constant pressure, specific heat for ideal gases. • the steady and unsteady process, • some steady-flow engineering devices,
10	• solve problems on steady-flow • solve problems on unsteady-flow
11	**The second law of thermodynamics:** • heat engines and heat pumps and their performance, • the reversible and irreversible process, • the causes of irreversibility, • Carnot's cycle and its performance, • Thermodynamic scale of temperature. • The second law of thermodynamics (physical description and examples)
12	**Entropy:** • inequality of Clausius, • entropy change of pure substance, • entropy change in a reversible and irreversible processes, • the uniform process, reversible adiabatic process, • entropy change of ideal gases, • a polytropic reversible process in ideal gases,
13	• the increase of entropy principle, • efficiency, • the second law of thermodynamics (closed systems)
14	• the second law of thermodynamics (open systems)
15	• solve problems • supplementary notes
16	**Exergy:** • irreversibility and availability, • reversible work, • work potential of energy

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (15%), Project (0%), Midterm (35%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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THERMODYNAMICS 2

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Thermodynamics 2, S4

Number of credits: 3

COURSE PREREQUISITES:

Thermodynamics 1

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

The main goal of this course is to apply the thermodynamic laws to different industrial systems & applications, such as gas and vapor power plants, refrigeration cycles. Moreover, the gas mixtures, combustion, and compressible flow are investigated. Students are expected to:

- ✓ Analyze different power plants and refrigeration cycles
- ✓ Have a good physical understanding of the gas mixtures behavior and compressible fluid flow.
- ✓ Be familiar with the combustion reactions and able to analyze combustion processes.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. R. E. Sonntag, C. Borgnakke, V. Wylen, Fundamentals of Thermodynamics, 10th Ed., Wiley, 2019.

2- K. Wark, Thermodynamics, 5th Ed., McGraw-Hill, New York, 1988.
3- G. V. Whylen, R. Sountag, Fundamental of Classical Thermodynamics, Wiley, 4th Ed., 1993.
4- M. J. Moran, H. N. Shapiro, Fundamentals of Engineering Thermodynamics, Wiley, 8th Ed., 2014.

Web links: -

Computer Software: EES

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	**Vapor and gas power cycles:** • Introduction, • Rankin cycle • The effects of different parameters on the efficiency of vapor power plants • Ideal and real cycles
2	• Solve problems • Otto and Diesel cycles • Stirling and Ericsson cycles
3	• Brayton cycle for gas turbines • The effects of different parameters on the efficiency gas turbine with regeneration • Jet-propulsion cycles
4	• Combined vapor-gas cycles • Solve problems
5	**Refrigeration cycles:** • Vapor-compression refrigeration cycle • Actual Vapor-compression refrigeration cycle • Solve problems
6	• Gas refrigeration cycles, • Absorption refrigeration systems
7	• Solve problems
8	**Thermodynamic property relations:** • Introduction: • The Maxwell relations • The Clapeyron equation • Internal energy changes • The Joule-Thomson Coefficient • Enthalpy changes, entropy changes, specific heats for ideal gases

	• Solve problems
9	• Enthalpy changes, entropy changes, specific heats for ideal gases • Solve problems
10	**Gas mixtures:** • The composition of a gas mixture: • Mass and mole fractions • Ideal-gas mixtures • Real-gas mixtures • Solve problems
11	• Gas–vapor mixtures and air-conditioning • Dry and atmospheric air • Specific and relative humidity of the air • Adiabatic saturation and wet-bulb temperatures • The Psychometric chart
12	• Solve problems
13	**Chemical reactions:** • Fuels and combustion • Theoretical and actual combustion processes • Enthalpy of formation and enthalpy of combustion • First-law analysis of reacting systems
14	• Adiabatic flame temperature • Second-law analysis of reacting systems • Solve problems
15	**Compressible flow:** • Stagnation properties • The speed of sound and Mach number • Isentropic flow • Isentropic flow through nozzles • Shock waves and expansion • Solve problems
16	• Normal and oblique shocks • Rayleigh flow • Steam nozzles • Solve problems

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (15%), Project (5%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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THERMODYNAMICS AND HEAT TRANSFER LABORATORY

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Core, Thermodynamics and Heat Transfer Laboratory, S6

Number of credits: 1

COURSE PREREQUISITES:

Thermodynamics 1, Heat Transfer 1

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Mechanical Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn basic about gas power and refrigeration cycles.
- ✓ Learn basic about cooling tower.
- ✓ Learn basic about Marcet boiler and determined boiling curve, enthalpy and entropy of vaporization.

REQUIRED STUDENT RESOURCES

Textbooks:

1. C. Borgnakke, R. E. Sontag, "Fundamentals of Thermodynamics", 8th Edition, John Wiley & Sons, 2012.
2. J. P. Holman, "Thermodynamics", 4rd Edition, McGraw-Hill, 1988.
3. Y. A. Cengel, "Thermodynamics: An Engineering Approach", 8th Edition, McGraw-Hill Higher Education, 2014.

References:

1. M. J. Moran, H. N. Shapiro, D. D. Boettner, M. B. Bailey, "Fundamentals of Engineering Thermodynamics", 7th Edition, John Wiley & Sons, 2010.

Web links: -

Computer Software: EES

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Marcet boiler and determined boiling curve, enthalpy and entropy of vaporization.
2	Single stage compressor.
3	Spark-ignition engines, Otto cycle, compression-ignition engines, diesel cycle.
4	Refrigerator/heat pump apparatus.
5	Vapor-compression refrigeration cycle.
6	Absorption refrigeration cycle.
7	Cooling tower.
8	Air Condition.

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Assignment "A"	10 points
Assignment "B"	10 points
Assignment "C"	10 points
Assignment "D"	10 points
Assignment "E"	10 points
Assignment "F"	10 points
Assignment "G"	10 points
Assignment "H"	10 points
Final Exam	120 points
Total Points	200 points

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SYLLABI ON WEB PAGES

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FLUID MECHANICS 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fluid Mechanics 1, S3

Number of credits: 3

COURSE PREREQUISITES:

Differential equations, Dynamics

COURSE CO-REQUISITES:

Thermodynamics 1

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn the basics fluid mechanics science and the roles governs the fluid flow.
- ✓ Introduce the behavior and properties of liquids and gases.
- ✓ Learn the governing equations of hydrostatic and hydrodynamic.
- ✓ Learn how to simplify the equations with reasonable assumptions and their implementation in solving.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. F. M. White, Fluid Mechanics, Mc-Graw Hill, 2015.
2- B. R. Munson, R. Y. Donald, et al, Fundamentals of Fluid mechanics, John–Wiley, 2015.
3- V. L. Streeter, E. B. Wylie, K. W. Bedford, Fluid Mechanics, Mc-Graw Hill, 2009.
4- B. S. Massey, Mechanic of Fluids, VNR, 2011.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	An introduction to fluid mechanics science, the philosophy of the course, and its application in mechanical engineering
2	Introducing the fluids properties and applicable concepts including pressure, shear stress, viscosity, density, specific gravity, cavitation, compressibility, surface tension, etc., and system of units in fluid mechanics
3	Hydrostatic: derivation of the fundamental equation of hydrostatic
4	Calculation of hydrostatic pressure in manometers, calculation of hydrostatic force and its point of application on the surfaces
5	immersed and floating bodies and their stability, rigid motion of fluids
6	The integral form of fluid flow equations, system and control volume concepts
7	The integral form of conservation equations, derivation of mass, momentum and energy equations
8	Practical samples of using conservation equations in flow problems
9	The differential form of fluid flow equations, continuity, momentum, and energy equations, Euler equations
10	Bernoulli equation, two-dimensional potential flow, irrotational flow
11	Applications and limitations of Bernoulli equation in fluid flow problems, practical samples of using the equations in flow problems
12	Dimensional analysis and model study, Buckingham's Pi-theorem, determination of non-dimensional groups for a problem
13	Mayer dimensional analysis method
14	Introducing universal dimensionless numbers, similarity and model study
15	Determination of velocity profile in different flows, simplification assumptions used for analytical solution
16	Introducing a differential cell and deriving the differential form of viscous flow governing equation (Navier-Stokes eqs.), determination of velocity profile in different applications

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (15%), Project (0%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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FLUID MECHANICS LABORATORY

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Fluid Mechanics Laboratory, S5

Number of credits: 1

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

Fluid Mechanics 1

TEACHERS:

Person in charge: Department of Mechanical Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ compare the results of analytical models introduced in a lecture to the actual behavior of real fluid flows
- ✓ discuss and practice standard measurement techniques of fluid mechanics and their applications
- ✓ learn and practice writing technical reports

REQUIRED STUDENT RESOURCES

Textbooks:

1. Fluid mechanics Laboratory student manual, Mechanical Engineering Department, 2nd revision, 2010.
2. R. Fox, A. McDonald, P. Pritchard, "Introduction to Fluid Mechanics", 6th Edition, John Wiley & Sons, 2006.
3. F. M. White, "Fluid Mechanics", 5th Edition, McGraw-Hill, 2002.

References:

1. B. Munson, D. Young, T. Okiishi, "Fundamentals of Fluid Mechanics", 6th Edition, John Wiley, Inc., 2009.

Web links: -

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Fluid flow measurement using different devices
2	Bernoulli's equation in the draining of a cylindrical tank: the free vortex
3	Impact of a jet on stationary vanes: linear momentum
4	Hydrostatic forces on submerged surfaces
5	Centrifugal pumps in Parallel and series arrangements
6	Flow of air in a convergent-divergent channel: contraction and expansion losses
7	Calculation of pressure loss in piping systems
8	Estimation of air boundary layer growth in a duct

EVALUATION PROCEDURES AND GRADING CRITERIA

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Assignment "B"	10 points
Assignment "C"	10 points
Assignment "D"	10 points
Assignment "E"	10 points
Assignment "F"	10 points
Assignment "G"	10 points
Assignment "H"	10 points
Final Exam	120 points
Total Points	200 points

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SYLLABI ON WEB PAGES

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MACHINE DESIGN 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Machine Design 1, S5

Number of credits: 3

COURSE PREREQUISITES:

Strength of Materials I, Dynamics

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn failure criteria of metals under static loading.
- ✓ Learn failure criteria of metals under dynamic loading.
- ✓ Learn the principles and methods of designing machine parts.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. J. E. Shigley and C. R Mischke, Mechanical Engineering Design, 10th Edition, McGrew–Hill, 2014.
2- Machinary Handbook, 25th Edition, Industrial Press Inc.
3- P. Orlov, Fundamental of Machine Design, MIR Publisher, 1982.
4- R. L. Norton, Design of Machine Elemants, 5th Edition, Pearson, 2013.
5- A. Samuel, J. Weir, Introduction to Engineering Design, Butterworth-Heinemann, 1999.

Web links: -

Computer Software: Solid Works

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction of design: Design definition, Decision in design, thinking method in design, Problem analysis, Forming and matching components, Design factors.
2-5	Admissible stresses: Stress diagram, Relative length variation, Stress concentration, Endurance limit of the body, Fatigue, Effective factors in fatigue strength, Fracture types of soft and brittle objects.
6-10	Shafts: Admissible stress in the shafts, cylindrical shafts, Maximum static shear stress, Load factors, Fatigue phenomena, Maximum shear stress in alternating loads, Power in shafts, Determination of shaft diameter by drawing and mathematical methods, Torsion of shafts with non-circular section, Commercial size of the shafts, Selection of the shafts, Critical speed, Keys, Stress concentration in shafts and keys, Types of couplings.
11	Springs: Coil springs, Properties of springs material, Endurance limit for steel of springs, Tables of properties of steel used in springs, Design for variable loads, Vibration on springs, Coil, tension, torsion, surface, branch and cone springs, Absorbed energy in springs
12-13	Connections: Screw shape and size, Tables of screw size, Types of tension connections, Heavy screw force table, Effect of primary tension in screws, Effect of spring washer and clamping joints, Nut selection, Transmission power screw, Efficiency for screws, Shotgun and differential screws, Screws and rivet in shear, non-axial loads, welding and its ability, Stress concentration in the welds, Welding due to non-centered loads, Tables of different weld and their relationships
14	Putting parts and tolerances: Putting parts, Table of admissible limit values and tolerances, putting with force, heat, and strength, putting wit force and heat versus slip, Shrinkage putting
15-16	Bearings: Viscosity, Bearings and its classification, Porter bearing, Mechanism of lubrication in bearing, Classification of variable, Calculation of bearings from the curve, Heat balance in bearings, bearing design in terms of oil thickness and temperature, Bearings with forced lubrication, Simple bearings, bearing materials, Bearing construction, Table of clearances for bearings, Radial shaft seal

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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MACHINE DESIGN 2

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Machine Design 2, S6

Number of credits: 3

COURSE PREREQUISITES:

Machine Design 1

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn the design of the required mechanical components in the industry.
- ✓ Familiar with standard parts in the design of mechanical components and their selection method.
- ✓ Learn the design of gear box.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. J. E. Shigley and C. R Mischke, Mechanical Engineering Design, 10th Edition, McGrew–Hill, 2014.
2- Machinery Handbook, 25th Edition, Industrial Press Inc.
3- P. Orlov, Fundamental of Machine Design, MIR Publisher, 1982.
4- R. L. Norton, Design of Machine Elements, 5th Edition, Pearson, 2013.
5- A. Samuel, J. Weir, Introduction to Engineering Design, Butterworth-Heinemann, 1999.

Web links: -

Computer Software: Solid Works

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1-4	Ball Bearings and Roller Bearings: Construction and different types of ball and roller bearings, Theory of ball and roller bearing, Life of ball bearing and selection method, Ball bearings table, Design of ball bearing for variable load, Pre-load in ball bearing and roller bearings, Comparison of bearings and ball bearings.
5-6	Belts: Leather, rubber, and tarpaulin belts, Force in flat belts, carrying belt on the belt wheels, Belt design by table, Table of belt types, Drive system for spacing between short centers, Trapezoidal belts (V), Expected life, Length of the belt.
7	Clutches and brakes: Disc and cone clutches, Friction materials for clutches and brakes, Different types of brakes, Comparison of brakes, Heat in brakes.
8-12	Spur gears: Dimensions of gears, Tooth law, Kinematic of involute, cycloid and standard gear, Manufacture of gears, Table of gear module, Power transmission of teeth, Table of Lewis factor, Dynamic load, Dynamic or commercial load, Load limit for wear, Table of amount (K), Wear factor, Number of mesh teeth, Material of gears.
13-16	Bevel, helical, worm gears: Various types of non-spur gears, bending strength of teeth, Dynamic force and wear load limit of bevel teeth, Helical- bevel gears, Helical gears, bending power and dynamic and wear forces of helical gears, Crosswise helical and worm gear, Bending power, Dynamic load, wear and efficiency of worm gears and their heat capacity

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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STRENGTH OF MATERIAL 2

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Strength of Materials 2, S4

Number of credits: 3

COURSE PREREQUISITES:

Strength of Materials 1

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn basic theories about the transformation of stress and strain.
- ✓ Calculate the principle and equivalent stress for the engineering problems.
- ✓ Solve indeterminate problems and deflection of beams and columns.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. Beer F., Johnson E., Dewolf J., Mazurek D. Mechanics of Materials. 7th edition. Mc Graw-Hill; 2014.
2. Hibbeler R. Mechanics of Materials. 9th edition. Prentice-Hall; 2014.

Web links: -

Computer Software: MATLAB

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Transformation of plane stress
2	Principle stresses, Maximum shear stress, Mohr's circle of stress
3	Transformation of plane strain
4	Principle strains, Maximum shear strain, Mohr's circle of strain
5	Types of the strain gage, Mohr's circle of stress and strain relation
6	Deflection of beams by direct integration method
7	Deflection of beams by Macaulay's functions method
8	Deflection of beams by superposition method
9	Deflection of beams by the moment-area method
10	Deflection of beams by the three-moment method
11	Elastic strain energy and external work, deflection by energy method
12	Deflection of structures by Castigliano's method
13	Minimum work law and statically indeterminate problems
14	Deflection of structures by virtual work method
15	Stability of equilibrium for columns
16	The Euler formula for columns with different end restrains

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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HEAT TRANSFER 1

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Heat Transfer 1, S5

Number of credits: 3

COURSE PREREQUISITES:

Thermodynamics 1, Fluid Mechanics 1

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to understand:

- ✓ Heat transfer phenomena and their importance and applications in engineering sciences.
- ✓ The heat transfer mechanisms consist of conduction, convection, and radiation.
- ✓ Mathematical modeling of heat transfer method and solution techniques of governing equations.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. T. L. Bergman, A. S. Lavine, D. P. DeWitt, F. P. Incropera, and A. S. Lavine, Introduction to Heat Transfer, 6th Edition, John Wiley & Sons, 2011.
2- J. H. Lienhard IV, and J. H. Lienhard V, A Heat Transfer Textbook, Phlogiston Press, 2000.
3- J. P. Holman, Heat Transfer, 10th Edition, McGraw-Hill, New York, 2010.

4- F. Kreith, M. S. Bohn, Principles of Heat Transfer, 6th Edition, Harper & Row, New York, 2000.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction to heat and the mechanisms of heat generation and transformation
2	Physical concepts and governing equations of heat conduction, convection and radiation
3	The relationship between heat transfer and thermodynamics, conservation of energy and its applications, system of units
4	Conduction heat transfer: thermal properties of materials and thermal conductivity, steady one-dimensional equation of heat conduction in multilayer walls in Cartesian, cylindrical and spherical coordinates
5	The plot of thermal resistance circuit and calculation of conductive heat transfer rate between the surfaces
6	Combined conduction and convection on the boundaries, overall heat transfer coefficient
7	One-dimensional heat conduction equation with heat generation source, general heat conduction equation, conduction heat transfer from variable cross-section geometries, heat transfer from extended surfaces (fins) and their performance
8	Two-dimensional heat conduction equation in steady-state at different coordinates systems, types of boundary conditions
9	Analytical solution of governing equation, a method of separation of variables
10	Discretization of the equation using finite difference technique, a method of discretization on the boundaries, explicit and implicit schemes in the numerical solution
11	Unsteady heat conduction: analytical solution (separation of variables) for an unsteady equation with simple boundary conditions
12	numerical solution of unsteady conduction equation using finite difference scheme, temperature uniformity, heat conduction in semi-finite and finite dimensions geometries
13	Convective heat transfer-external flow: definition of convective heat transfer coefficient, hydrodynamic and thermal boundary layers, dimensionless numbers
14	Empirical relations for calculation of convective heat transfer coefficient in laminar and turbulent flows over the bodies, heat convection in flow pasts over cylinders, spheres, and a bunch of pipes
15	Convective heat transfer-internal flow: hydrodynamic and thermal boundary layer development in pipes, constant temperature and constant heat flux boundary conditions, empirical relations for calculation of convective heat transfer coefficient in laminar and turbulent flows through channels, convective heat transfer in non-circular ducts
16	Radiative heat transfer: radiation intensity and radiative wave propagation, black and gray bodies irradiation, shape and surface coefficients, radiation between black and gray bodies, the plot of thermal resistance circuit and calculation of radiative heat transfer between surfaces

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (10%), Project (5%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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MECHANICAL VIBRATION

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Mechanical Vibration, S5

Number of credits: 3

COURSE PREREQUISITES:

Engineering Mathematics and Dynamics

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

Familiarity of students with different vibrational mechanisms and principles and relationships governing vibrational systems and their analysis methods

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. W. T. Thomson and M. D. Dahleh, Theory of Vibration with Application, 1st Edition, CRC Press, 2017.
2. L. Meirovitch, Elements of Vibration Analysis, 2nd Edition, McGrew-Hill, 1986.

Web links: -

Computer Software: MATLAB, Abaqus

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Oscillatory motion: definitions, harmonic motion and periodic motion, oscillatory motion properties
2	Degrees of freedom, mathematical model of dynamic systems, linear and nonlinear systems
3	Free vibration: system equation of motion system using newton's law, D'Alembert's principle, energy method
4	Types of linear systems one degree of freedom without depreciation or linear depreciation, logarithmic decrement,
5	Effective mass and combination of masses
6	Forced vibration: Types of external excitations, stable vibrations using the complex number method
7	Time response, System frequency to input excitation, force and basic displacement, super position, general motion of system, torsional vibrations of rods, induction vibrations of systems due to the rotation of the mass eccentric and reciprocating motion,
8	Application of vibrations: Application of springs and viscous damper in parallel and under angle, dissipated energy by viscous damper coulomb, equivalent viscous damper, reduce vibrations and isolation, types of isolators
9	Force transfer capability and absolute and relative displacement, calculation of depreciation by empirical method, viscoelastic damper
10	Vibrations with non-harmonic excitation, reactions of one-degree-of freedom systems to non-harmonic waves,
11	impulse effect, convolution, Duhamel integral, Laplace transform, computer methods in solving vibrational equations
12	Two degree of freedom systems: vibrations differential equations by free body method, natural modes, use the Mohr's circle, general motion of system, global coordinate, principal coordinate, beating phenomenon
13	Linear free vibrations, forced vibration, dynamic absorber of vibrations, types of industrial absorbers, rigid body mode, vibrations of dependent systems, energy method for obtaining motion equations
14	Critical speed of Rotating shaft: Shaft carrying a disc, critical speed, dynamic deviation of shafts
15	effect of depreciation and friction on the critical speed of the shafts, shaft carrying multi discs, gyroscopic effect,
16	Multidegree-of-freedom systems: a reference to the vibrations of Multidegree-of-freedom systems, continuous systems, vibrations of cables and beams

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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DYNAMICS AND VIBRATIONS LABORATORY

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Dynamics and Mechanical Vibrations Laboratory, S7

Number of credits: 1

COURSE PREREQUISITES:

Mechanical Vibration

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Mechanical Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ Perform some practical test in the field of vibration.
- ✓ Perform some practical test in the field of dynamics of machines.
- ✓ Learn how to prepare a scientific report.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. W. T. Thomson and M. D. Dahleh, Theory of Vibration with Application, 1st Edition, CRC Press, 2017.
2. Uicker J. J., Pennock G. R., Shigley J. E. Theory of Machines and Mechanisms, 5th Edition, McGraw-Hill; 2016.
3. L. Meirovitch, Elements of Vibration Analysis, 2nd Edition, McGrew-Hill, 1986.

Web links: -

Computer Software:

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction, Vibration absorber
2	Free and forced vibration in a 1DOF system with and without Damping.
3	Free torsional vibration in 1DOF and 2DOF systems.
4	Critical rotational speed in the rotating shaft.
5	Cam and follower.
6	Gyroscopic effects.
7	Balancing a system of rotating masses.
8	Governors.
9	Single and double Hooke joints.

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Reports	80 points
In-lab activities	20 points
Attendance	20 points
Final Exam	80 points
Total Points	200 points

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SYLLABI ON WEB PAGES

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AUTOMATIC CONTROL

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Automatic Control, S6

Number of credits: 3

COURSE PREREQUISITES:

Fundamentals of Electrical Engineering, Mechanical Vibration

COURSE CO-REQUISITES:

Fluid Mechanics 1, Heat Transfer 1

TEACHERS:

Person in charge: Dr. Pegah Hamedani
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37934262
Email Address: p.hamedani@eng.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Familiarize students with different control systems and their design and analysis methods.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. K. Ogata, Modem Control Engineering, 4th Edition, Prentice–Hall, 2002.
2. Richard C. Dorf, and Robert H. Bishop, Modern control systems, Pearson Prentice Hall, 2008.

Web links: -

Computer Software: MATLAB

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction to control systems
2	Definition and classification of systems, examples of control systems
3	System representation using block diagram, feedback, open-loop control systems and closed-loop control systems and their comparison
4	Reminder Laplace transform
5	Mathematical modeling of control systems
6	System transfer function and impulse response function, automatic control systems, draw a block diagram
7	Modeling in state space, representation dynamic systems in state space
8	Mechanical systems, electrical systems, signal flow graphs
9	Mathematical modeling of mechanical systems involving working fluid and thermal systems
10	Systems time response, transient and steady-state response analyses
11	First-order systems, higher-order systems, Routh's stability criterion
12	Effects of integral and derivative control actions on system performance, effects of steady-state errors, effects of steady-state errors
13	Root-locus method
14	Root-locus plots, positive feedback systems
15	Control systems design by root locus method
16	Frequency response of systems

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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GENERAL RULES OF MOVEMENT OF TRAINS

BASIC INFORMATION

Place in Curriculum, title and semester: Core, General Rules of Movement of Trains, S2

Number of credits: 2

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Dr. Pegah Hamedani
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37934262
Email Address: p.hamedani@eng.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

This course aims to familiarize with the general rules of movement and technical instructions about the staff and duties of officers who deal with the trains' movement.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. Islamic Republic of Iran Railways (RAI), General regulations of railway traffic, RAI, 2013.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Definitions, schedule of trains, timetable, block, disconnection, movement of operation trains
2	Train movement using electrical signals, audio and visual signals
3	Familiarizing with the rolling-stocks signs and the rail side signs
4	Freight and passenger wagons, European wagons, and locomotives numbering
5	Knowing the duties of station personnel
6	Learning the duties of train personnel
7	Calculation of weight and braking ratio
8	Calculating the speed and braking ratio in trains' formation according to the maximum length
9	Maneuver and shunting operations and their requirements
10	Instructions related to the transportation of dangerous goods
11	Guidelines and requirements related to train derailment
12	Interlocking signal system

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (0%), Project (60%), Midterm (20%), Final (20%)

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SYLLABI ON WEB PAGES

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DESIGN OF WAGON AND LOCOMOTIVE STRUCTURE

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Design of Wagon and Locomotive Structure, S6

Number of credits: 3

COURSE PREREQUISITES:

Statics, Dynamics, Mechanical Vibration

COURSE CO-REQUISITES:

Materials Science in Railway

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	-	-	1 h

COURSE OBJECTIVES

Familiarizing students with the methods and principles governing the design and analysis of the body and structures used in the bodies of freight and passenger cars or locomotives.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. A. H. Wickens, Fundamentals of Rail Vehicle Dynamics, CRC Press, 2003.
2- K. Knothe, and S. Stichel, Rail Vehicle Dynamics, Springer, 2017.

Web links: -

Computer Software: Ansys, Abaqus

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction (types of wagon and locomotive structures)
2	Metal pipes under side loads and impact energy absorbed by them
3	Static analysis of plastic deformation and absorbed energy by a steel structure with thin walls of plate crushing theory
4	Energy absorbed by a collapsed structure
5	Axial crushing of composite pipes
6	Calculation of forces entering the structure (wind, compressive and tensile forces caused by other wagons, loads, etc.)
7	Analysis of the structure caused by kinetic and longitudinal forces
8	Structural analysis of torsional forces at static and impact
9	Loading mechanism on the frame in passenger and freight car or locomotive
10	Designing all kinds of draw gear
11	Designing all kinds of buffer
12	Mathematical model of a railway car
13	Investigating the dynamic response of the loads applied to railway car
14	Train buckling (effect of axial and lateral loads and obtaining different train buckling modes)
15	Calculation of the sacrificial area
16	Introduction of related UIC standards

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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RAILWAY VEHICLE DYNAMICS

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Railway Vehicle Dynamics, S6

Number of credits: 3

COURSE PREREQUISITES:

Dynamics and Mechanical Vibration

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	-	-	1 h

COURSE OBJECTIVES

Familiarize students with the principles and rules governing the movement of trains and different methods of analyzing this type of movement.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. R.V. Dukkipati, Vehicle Dynamics, Alpha Science International, 2000.
2. S. Iwnicki, S. Iwnicki, Handbook of Railway Vehicle Dynamics, CRC Press, 2006.

Web links: -

Computer Software: Universal Mechanics (UM), Adams rail

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Investigation of forces between wheels and rails and analysis of train behavior in acceleration and braking and in the profile of the wheel and rails cross sections
2	adhesion coefficient (friction coefficient), the force between rails and wheels
3	description of types of resistance to train motion (air, friction, Slope, arc, tunnel, needle, etc.)
4	description of types of resistance to train motion (air, friction, Slope, arc, tunnel, needle, etc.)
5	traction force, traction force and locomotive speed diagram
6	Davis equation, slope classification (governing slope, zero slope, kinetic acceleration slope)
7	Davis equation, slope classification (governing slope, zero slope, kinetic acceleration slope)
8	equations for calculating train weight and distributing forces on Wheels, Equations for calculating train weight
9	equations for calculating train weight and distributing forces on Wheels, Equations for calculating train weight
10	Drawing and Analyzing Train Motions, Time and Distance Equations
11	Calculate the ratio of locomotive mechanical work to fuel consumption in a train
12	Dynamic behavior of the train in acceleration, braking and arc mode, Wheel and rail rotation in the three above modes
13	Dynamic behavior of the train in acceleration, braking and arc mode, Wheel and rail rotation in the three above modes
14	Train command in the arcs and forces between wheels and rails
15	Lateral and stability forces, effect of lateral impacts, Static forces on conical wheels and worn wheels
16	Lateral and stability forces, effect of lateral impacts, Static forces on conical wheels and worn wheels

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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DESIGN OF TRAIN BRAKES

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Design of Train Brakes, S7

Number of credits: 2

COURSE PREREQUISITES:

Machine Design 2

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

The aim design of train brakes is familiarizing students with train braking mechanism and different methods of designing and analyzing brake performance in trains.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. R. Limepert, Brake Design and Safety, SAE, 2011.
2- Rail Vehicle Brakes Handbook, Brake Engineering Terms and Date, Knorr-Bremse, 1995.

Web links: -

Computer Software: Ansys Fluent

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	An introduction about the movement and kinetic energy of vehicles, recognition of resisting forces in movement, the curve of resisting forces and speed
2	The relationship between the amount of brake force with weight and speed
3	The formula and diagram of the stopping distance at different speeds, the stopping time table according to different accelerations
4	How to generate braking force, calculations of power transmission to the wheel, calculation of brake weight and braking ratio
5	The curve for the relationship of braking percentage with increasing the brake weight and releasing time
6	Identifying the types of brakes, duties, disadvantages and advantages of each.
7	Friction brakes, curve of friction coefficient and speed, changes of friction coefficient in different conditions
8	Conditions of an optimal brake, diagram of braking and friction force of movement in different situations.
9	Characteristics of air brakes, compressed air production, types of compressors.
10	Design of brake pneumatic circuit
11	Automatic air brake mechanism
12	Definition of independent brake, equipment and stability of brake weight
13	Equalizing equipment and brake release operation throughout the train, brake test.
14	Magnetic brakes
15	Vacuum brakes
16	Hydrodynamic brakes

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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DESIGN OF RAILWAY ROLLING STOCK

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Design of Railway Rolling Stock, S7

Number of credits: 2

COURSE PREREQUISITES:

Dynamics, Fundamentals of Railway Substructure and Superstructure

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

The aim in design of rail cars is identifying the types of rolling stock and their working mechanism and presenting the design criteria and operational flow chart for the design of these machines.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. R. L. Norton, Design of Machinary, McGraw Hill, 2003
2- J. E. Shigley, J. J. Uicker, Theory of Machines and Mechanisms, Mc Graw Hill, 2017.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Getting to know the operating mechanism and providing design criteria for paving and operating machines
2	Measuring machine
3	Packing machine and switch gear tamping machine
4	Regulator machine
5	Stabilizer machine
6	Ballast screener
7	Track laying machine
8	Rail-welding machine
9	Snow-plough machine
10	Rail-grinding machine
11	Sand-clearing machine
12	Rail replacer machine
13	Rail wheel lathe
14	Fault detection machine
15	Crack detection machine
16	Designing the mechanism of the device and components, formulating the problems and presenting the methods of correction and improvement, etc.

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (0%), Project (15%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

Syllabi presented on web pages shall contain the date of last update.

TECHNOLOGY OF CONSTRUCTION AND REPAIR OF RAILWAY ROLLING STOCK

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Technology of Construction and Repair of Railway Rolling Stock, S8

Number of credits: 3

COURSE PREREQUISITES:

Design of Wagon and Locomotive Structure

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	1 h	1 h

COURSE OBJECTIVES

The aim in Technology of Construction and Repair of Rail Vehicles is familiarity with all kinds of manufacturing processes and providing methods of rebuilding and repairing parts.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. S. Kalpakjian, Manufacturing Process for Engineering Materials, Addison-Wesley Publisher, 2016.
2- ASM, Metals Handbook, 9th Edition, Vol. 15, Casting, 1998.
3- J. L. Feirer, General Metals, Mc Graw-Hill, 1998.
4- J. k. Lindebeck, M. W. Wiliams, Manufacturing Technology, Prentice Hall, 1990.

Web links: -

Computer Software: Abaqus

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Casting processes (in sand, in permanent molds, die cast methods, ingot production methods)
2	familiarity with the production processes of cast wheels and cast bogies
3	Coating processes (electroplating, chemical plating, conversion processes, mechanical plating, metal spraying, plating, painting)
4	Machining processes, turning and milling, capacitor drawing, grinding, spark NC, CNC, familiarization with turning blades and stone materials/gear grinding machines
5	Welding processes (electric arc, sub-powder, Flux, Cored, MTG, TIG, gas welding, thermite welding...)
6	welding standards, preparation of PQR, WPS, reconstruction by welding (rehabilitation of wheels and rails), introduction of welding defects
7	Forming processes (rolling, forging, extrusion, deep drawing, wire drawing, spinning, sheeting, cutting) Fabricated bogies production process
8	Introduction of industrial presses
9	NDT processes (ultrasonic X RAY, acoustic methods, visual methods)
10	Inspection of wheel and rail defects through NDT, non-destructive examination of welding defects, Familiarity with commands
11	Methods of rebuilding turbochargers
12	Methods of rebuilding diesel engines
13	Methods of rebuilding electric machines, aligning the engine and generator
14	Balance of rotating parts
15	Adaptations
16	Production methods of polymer parts

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

ATTENDANCE STATEMENT

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STUDENTS WITH DISABILITIES ACT FOR STUDENTS WITH SPECIAL NEEDS STATEMENT

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APPROVED ACADEMIC HONESTY STATEMENT

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SYLLABI ON WEB PAGES

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ELECTRIC RAILWAY

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Electric Railway, S6

Number of credits: 2

COURSE PREREQUISITES:

Fundamentals of Electrical Machines, Fundamentals of Communication and Signaling 1

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Dr. Pegah Hamedani
Office location: Department of Railway Engineering, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37934262
Email Address: p.hamedani@eng.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

Students are expected to become familiar with the following topics:

- ✓ Fundamentals of electric railway
- ✓ Structures and components of overhead power supply and third rail system
- ✓ Introduction of different traction substations and their applications
- ✓ Structures of transformers connections in traction substations

REQUIRED STUDENT RESOURCES

References:

1. M. Brenna, F. Foiadelli, D. Zaninelli, Electrical Railway Transportation Systems, Wiley-IEEE Press, 2018.
2. F. Kiessling, R. Puschmann, A. Schieder, E. Schneider, Contact Lines for Electric Railways: Planning, Design, Implementation, Maintanence, 3rd edition, Simense, 2018.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction of electric railway, electrification history, and electrification economy
2	Advantages and disadvantages of railway electrification, comparison of electric and diesel locomotives characteristics of Siemens
3	All types of traction power supply and different voltage levels for suppling electric railways according to standards
4	Review of transformer connections used in traction substations (single-phase, three-phase, V-V, T-T, and Scott transformers)
5	Characteristic of the electric railway load and its impact to power grid
6	Introduction of different traction substations and their applications (traction, sub-sectioning, paralleling, AT, and BT posts)
7	Phase rotation technique
8	OCS structure types (simple, BT with and without return conductor, AT, and simple with return conductor)
9	OCS structure and components (catenaries, supports, feeding and return wires, earthing and bonding)
10	OCS electric circuit types according to operational speed
11	OCS mechanical sectioning and tensioning, OCS zigzagging
12	Third rail introduction and components
13	Third rail advantages and disadvantages
14	Rigid overhead catenary system
15	Traction types used in electric railway, introduction of linear motors and Maglevs
16	Summarizing the course material along with showing real pictures of electric railway lines around the world and showing some educational films related to the course topics.

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (10%), Project (0%), Midterm (40%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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DESIGN OF BOGIE, WHEEL AND AXLE

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Design of Bogie, Wheel and Axle, S7

Number of credits: 2

COURSE PREREQUISITES:

Machine Design 2, Mechanical Vibration

COURSE CO-REQUISITES:

Design of Wagon and Locomotive Structure

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	-	-	1 h

COURSE OBJECTIVES

The aim in design of bogie and wheelset is calculation of dynamic behavior for bogie and wheelset. Students are expected to become familiar with the following topics:

- ✓ the types of bogies
- ✓ the forces acting on the bogie and its effect on the dynamic behavior of the train
- ✓ stress analysis in the bogie structure
- ✓ dynamic studies and investigating the motion stability of the bogie and wagon

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. V. K. Garg, R. V. Dukkipati, Dynamics of Railway Vehicle Systems, Asademic Press, 2012.
2- Spring Desing Manual, SAE Hnadbook, 1996.
3- ABC, OF Car and Locomotive Wheels, Simmons-Boardman Books, Inc, Omaha, USA, 1986.

Web links: -

Computer Software: Abaqus, Adams rail

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction of bogies (number of axles, rigid and steerable, tilting bogies, special bogies, introduction of bogies components)
2	Calculation of forces on the bogie structure, mass without spring (minimizing the mass on the spring and relating the mass to the wear and depreciation of the bogie parts)
3	Calculation of the forces on the bogie during acceleration, braking in the arc, forces on the wheel
4	Introducing the types of wheels, determining the wheel profile, designing the geometric form and choosing the wheel materials
5	Vertical stability, investigating effect of absorber on vertical stability, railway vehicle suspension systems, ride comfort and ride quality
6	Dynamic models of bogies and wagons
7	Checking the motion stability of bogies and wagons
8	Studying the design of leaf springs
9	Studying the design of air springs
10	Studying the design of spiral springs
11	Studying the design of wheelset
12	Studying the resistance force such as rolling resistance, bearing resistance, air resistance, ….
13	Studying the longitudinal train dynamics & the risk of derailment
14	Investigating wheel and truck failures
15	Determining the static and vibration behavior of bogie frame
16	Calculating wear on the wheel (due to static and dynamic load)

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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LOCOMOTIVE DESIGN

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Locomotive Design, S7

Number of credits: 3

COURSE PREREQUISITES:

Fundamentals of Electrical Machines, Design of Wagon and Locomotive Structure

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	-	-	1 h

COURSE OBJECTIVES

Familiarizing students with types of locomotives, components of locomotives and principles governing the operation of locomotives.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. J. G. Meyer, Modern Locomotive Design, 1982.
2- E. L. Ahrons, The British Steam Railway Locomotive, 1825-1925, Locomotive publishing Company limited, 1927.
3- M. Evans, The Model Steam Locomotive: A Complete Treatise on Design and Construction, 1983.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction of locomotive's types
2	Diesel mechanic locomotive
3	Diesel electric locomotive
4	Diesel hydraulic locomotive
5	Investigating the types of locomotive applications (passenger or freight wagon)
6	Hydrodynamic resistance force
7	Rolling resistance force
8	The resistant force of arc, slope and etc.
9	Movement resistances (braking and acceleration force)
10	Introducing the locomotive generator
11	Familiarity with locomotive power transmission system
12	Explaining the operation of engine traction
13	Familiarity with the cooling system in the locomotive
14	Introducing the fuel supply system in locomotives
15	Investigating the water supply system in the locomotive
16	Introducing the locomotive oil regulator system

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (0%), Project (15%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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MATERIALS SCIENCE IN RAILWAY

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Materials Science in Railway, S4

Number of credits: 3

COURSE PREREQUISITES:

Application of Chemistry for Railway

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	-	-	1 h

COURSE OBJECTIVES

Students are expected to:

✓ Learn about the application of materials science in rolling stock engineering

✓ Familiar with different experimental tests and standards for characterization of materials

✓ Justify the macro-mechanical behavior of different materials according to their micro-structures

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. D. William, J. R. Callister, D. G. Rethwisch, Materials Science and Engineering: An Introduction, 2018.
2- P. Polukhin, Physical principles of Plastic Deformation, Mir Publisher, 1983.
3- J. C. Scully, The Fundamentals of Corrsion, Pergammon Press, 1975.

4- Engineering Guides to Composite Materials, ASM International 1987.
5- M. M Eisenstaddt, Introduction to Mechanical Properties of Materials, Macmillan,1971.

Web links: -

Computer Software: PowerPoint, Excel

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introduction to materials science
2	Overview of atomic structure and interatomic bonding
3	The Structure of Crystalline Solids-Metals
4	The Structure of Crystalline Solids-Ceramics
5	Imperfections in Solids
6	Imperfections in Solids
7	Imperfections in Solids
8	Mechanical Properties of Metals
9	Mechanical Properties of Metals
10	Mechanical Properties of Ceramics
11	Dislocations and Strengthening Mechanisms
12	Dislocations and Strengthening Mechanisms
13	Failure of materials: Fracture mechanics
14	Failure of materials: Fatigue and creep
15	Phase Diagrams
16	Phase Diagrams

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (5%), Project (10%), Midterm (35%), Final (50%)

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SYLLABI ON WEB PAGES

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WELDING AND PLATING WORKSHOP

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Welding and Plating Workshop, S2

Number of credits: 1

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Mechanical Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn about the fundamentals of metal cutting and welding processes.
- ✓ Learn different methods of welding in industries.
- ✓ Know how to use different cutting, forming and binding instruments.

REQUIRED STUDENT RESOURCES

Textbooks:

1- T. Remus, "Advanced Sheet Metal Fabrication", Wolfgang Publications, Inc. 2003.
2- B. Smith, "Welding Practice", Butterworth-Heinemann, 1995.
3- L. Jeffus, "Welding: Principles and Applications", Delmar Cengage Learning, 6th Edition, 2007.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	An introduction to welding and cutting processes
2	Safety in welding and cutting processes
3	Welding with Oxyacetylene, Equipment of Oxyacetylene welding, Additional supplies of Oxyacetylene welding
4	Arc DC welding, Equipment of arc DC welding, Cutting with an electric arc, Equipment of arc welding
5	Soldering
6	Resistance welding, Braze welding
7	A complete description on different instruments and cutting of galvanized and black sheet metals using ruler needle, drawing of different curves on a 1mm sheet metal in circular and helical shapes and cutting them using curved scissors
8	Crosswise formation of the iron hoop as stencil curves using hammer forging, riveting of sheet metals with different types of rivets, Manufacturing of cylindrical pipes, Pipe making with hand or with rollers, Bending of a sheet with bending machine, connecting the round and quadrangle channels

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Report “A”	10 points
Report “B”	10 points
Report “C”	10 points
Report “D”	10 points
Report “E”	10 points
Report “F”	10 points
Report “G”	10 points
Report “H”	10 points
Final Exam	120 points
Total Points	200 points

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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MACHINE TOOLS WORKSHOP

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Machine Tools Workshop, S4

Number of credits: 1

COURSE PREREQUISITES:

-

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Mechanical Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Students are expected to:

- ✓ Learn how to work with different drilling machines
- ✓ Learn how to work with lathe and milling machines.
- ✓ Learn to work with grinder machine.

REQUIRED STUDENT RESOURCES

Textbooks:

1- R. Miller, "Machine Shop Tools and Operations", Audel, 5th Edition, 2004.
2- R. R. Kibbe, J. E. Neely, W. T. White, R. O. Meyer, "Machine Tool Practices", 9th Edition, Prentice Hall, 2009.
3- S. F. Krar, A. R. Gill, P. Smid, S. Krar, "Technology Of Machine Tools", 6th Edition, McGraw-Hill Higher Education, 2004.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Identification of different tools and their applications, Saw machines, Safety of saw machines, Jigsaw and horizontal band saw machines, Abrasive saw, Vertical band saw machines
2	Drilling machines, Safety of drilling machines, Types of drilling machines, cutting tools and applications, Drill sharpening, Drilling, Tapping, Conical drilling
3	Lathe machines, Safety of lathe machines, Types of lathe machines, Lathe machine operation, Drilling, Facing, Sanding, Internal turning, Cone turning, and knurling with a lathe machine
4	The ability of machining, Calculation of cutting and rotation speeds in machine tools, Geometry, and material of cutting tools, Material of workpiece, Coolant materials, and the machine power
5	Milling machines, Safety of milling machines, Types of milling machines, Milling machine operation, Facing, Threading and Knurling with a milling machine.
6	Grinder machines, Safety of grinder machines, Types of grinder machines, Grinder machine operation, Surface grinder, Angle grinder, etc.

EVALUATION PROCEDURES AND GRADING CRITERIA

Indicate how students are evaluated, including tests, quizzes, papers, assignments, the weight of the assignments, etc. Identify how the course grades are determined, clearly.

Report “A”	10 points
Report “B”	10 points
Report “C”	10 points
Report “D”	10 points
Report “E”	10 points
Report “F”	10 points
Final Exam	40 points
Total Points	100 points

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SYLLABI ON WEB PAGES

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WAGON AND BRAKE WORKSHOP

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Wagon and Brake Workshop, S6

Number of credits: 1

COURSE PREREQUISITES:

Design of Train Brakes, Design of Wagon and Locomotive Structure

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Giving objectivity to students' knowledge about how to design freight and passenger cars and the methods of analysis and design of brake mechanism.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. Student manual of wagon and brake workshop, Department of railway engineering, Iran university of science and technology, Iran.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Introducing all types of wagons and components
2	Wagon movement mechanism and inspection equipment
3	Introducing the braking system and inspection procedure
4	Maintenance process of bogie, frame and wagon
5	Bogie overhaul
6	Changing wheelsets and axles
7	Brake mmaintenance and overhaul
8	Fitting wheels, tyre and rims
9	Measuring and sizing tyre
10	Draw gear and buffer maintenance
11	Fault detection of wagon
12	The working method of fault detection devices
13	Wheel reprofiling process
14	Gear box maintenance
15	Bearing maintenance and inspection
16	Introducing the mechanical and electrical facilities of the wagon

EVALUATION PROCEDURES AND GRADING CRITERIA

Reports (50%), Project (0%), Midterm (0%), Final (50%)

ATTENDANCE STATEMENT

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SYLLABI ON WEB PAGES

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LOCOMOTIVE WORKSHOP

BASIC INFORMATION

Place in Curriculum, title and semester: Core, Locomotive Workshop, S7

Number of credits: 1

COURSE PREREQUISITES:

Locomotive Design

COURSE CO-REQUISITES:

-

TEACHERS:

Person in charge: Department of Railway Engineering
Office location:
Phone Number:
Email Address:

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
-	-	1 h	-

COURSE OBJECTIVES

Giving objectivity to students' knowledge about various elements used in locomotive design and construction.

REQUIRED STUDENT RESOURCES

Textbooks and References:

1. Student manual of Locomotive Workshop, Department of railway engineering, Iran university of science and technology, Iran.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week 16	Topic
1	Explanations about diesel engines
2	Introduction of diesel engine components
3	Diesel engine speed adjustment method
4	Injector pump adjustment method
5	Introducing the fuel supply mechanism
6	Lubrication system, diesel engine troubleshooting and adjustment tools and equipment
7	introduction of generator, mechanism of coupling diesel engine with generator
8	Familiarity with Locomotive control components and circuits,
9	Daily inspections and turning off the locomotive or starting method
10	Diesel engine overhaul and separating the components then maintenance and adjustments
11	Overhauling the generator and its troubleshooting
12	Dismounting the bogie and electric motors and their troubleshooting
13	Fault detection of diesel engine oil system
14	The method of vibrations fault detection
15	The method of noise detection
16	The method of fault detection by oil and water temperature.

EVALUATION PROCEDURES AND GRADING CRITERIA

Reports (50%), Project (0%), Midterm (0%), Final (50%)

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SYLLABI ON WEB PAGES

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FUNDAMENTALS OF ELECTRIC POWER CONVERTERS IN RAILWAY

BASIC INFORMATION

Place in Curriculum, title and semester: Optional, Fundamentals of Electric Power Converters in Railway, S8

Number of credits: 3

COURSE PREREQUISITES:

Fundamentals of Electrical Engineering

COURSE CO-REQUISITES:

Fundamentals of Electrical Machines

TEACHERS:

Person in charge: Dr. Mahmudreza Changizian
Office location: Department of Railway Engineering and Transportation Planning, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37932433
Email Address: m.changizian@cet.ui.ac.ir

WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
3 h	1 h	-	1 h

COURSE OBJECTIVES

Students are expected to become familiar with the following topics:

- ✓ Industrial electronic components
- ✓ Various power converters used in trains and traction substations
- ✓ Methods for controlling the speed of DC and AC traction motors

REQUIRED STUDENT RESOURCES

References:

1. Daniel W. Hart, Power Electronics, McGraw Hill, 2010.
2. M. H. Rashid, Power Electronics: Circuits, devices, and applications, Pearson Prentice Hall, 2014.
3. N. Mohan, T. M. Undeland, and W. P. Robbins, Power Electronics, Converters, Applications and Design, 3rd ed., Wiley, 2002.
4. B. K. Bose, Modern Power Electronics and AC Drives, Pearson India, 2015.

Web links: -

Computer Software: Matlab/Simulink

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Introduction to industrial electronic components and their characteristics (voltage, current, power, switching speed): Diodes, thyristors, triacs, diacs, power transistors, IGBT, GTO, power MOSFETs, and etc.
2	AC/DC Converters: Single-phase diode converters (under various loads: R, L, R-L, R-L-E)
3	AC/DC Converters: Single-phase thyristor converters (under various loads: R, L, R-L, R-L-E)
4	AC/DC Converters: Multi-phase diode converters (under various loads: R, L, R-L, R-L-E)
5	AC/DC Converters: Multi-phase thyristor converters (under various loads: R, L, R-L, R-L-E)
6	AC/DC Converters: Half-controlled rectifiers
7	AC/DC Converters: natural commutation and forced commutation
8	AC/DC Converters: controlled converter operating as an inverter
9	AC/DC Converters: Multi-pulse diode rectifiers with phase-shifting transformers at the input
10	Classification of converters according to operating region (single-region, two-region, and four-region converters)
11	DC/DC Converters: Choppers (with natural and forced commutation and various components)
12	DC/AC Converters: Single-phase and three-phase inverters, current and voltage source inverters
13	DC/AC Converters: three-phase inverters, current and voltage source inverters
14	AC/AC Converters: frequency converters (cycloconverters)
15	Harmonic analysis of power converters (DF, HF, THD, etc.): Performance parameters
16	Classification of electric locomotives, resistive braking and dynamic braking, speed control of DC and AC traction motors

EVALUATION PROCEDURES AND GRADING CRITERIA

HWs (10%), Project (10%), Midterm (40%), Final (40%)

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FUNDAMENTALS OF MAGNETIC AND HIGH-SPEED TRAINS

BASIC INFORMATION

Place in Curriculum, title and semester: Optional, Fundamentals of Magnetic and High-Speed Trains, S8

Number of credits: 2

COURSE PREREQUISITES:

Fundamentals of Electrical Engineering

COURSE CO-REQUISITES:

Fundamentals of Electrical Machines

TEACHERS:

Person in charge: Dr. Mahmudreza Changizian
Office location: Department of Railway Engineering and Transportation Planning, Faculty of Civil Engineering & Transportation, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran.
Phone Number: +98 (31) 37932433
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WEEKLY HOURS

Theory	Problem Solving	Laboratory	Guided learning
2 h	1 h	-	1 h

COURSE OBJECTIVES

The aim of this course is to familiarize students with the principles of operation, construction, and analysis of linear electric traction motors and various technologies of magnetic levitation trains (Maglev).

REQUIRED STUDENT RESOURCES

References:

1. A. Shiri and A. Shoulaie, "Linear Motors: Analysis, Design, and Modeling," Shahid Rajaee Teacher Training University Press, 2016.
2. A. Vahedi, "Special Electric Machines," Sharif University of Technology Press, 2014.

3. H. Yaqoobi Sarai, "Maglev Trains," Pouyan Farangar Publications, 2008.
4. S. Farshad, "Fundamentals of Electric Railways," Educational Notes of Iran University of Science and Technology, 2006.

Web links: -

Computer Software: -

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Week	Topic
1	Overview of Principles and Construction of Rotating Electric Motors: Traction DC motors (basic relationships and equivalent circuits)
2	Overview of Principles and Construction of Rotating Electric Motors: Traction induction motors (basic relationships and equivalent circuits)
3	Overview of Principles and Construction of Rotating Electric Motors: Traction synchronous motors (basic relationships and equivalent circuits)
4	Principles and Construction of Three-Phase Linear Induction Motors
5	Short primary or short secondary linear induction motors
6	Single-Sided, Double-Sided, and tubular linear induction motors
7	Types of primary windings in linear induction motors
8	Comparison of rotating magnetic field and linear magnetic field concepts
9	Theory of operation for linear induction motors, the relationship between speed and slip, efficiency and its relation to slip and motor power
10	Methods for starting linear induction motors, transient and steady-state performance analysis of the linear induction motor
11	Principles and Construction of Linear Synchronous Motors: Construction of wound linear synchronous motors
12	Principles and Construction of Linear Synchronous Motors: Construction and Operation of magnetic linear synchronous motors
13	Speed and power relationships for the linear synchronous motor, methods for starting linear synchronous motors, Transient and steady-state performance analysis of the linear synchronous motor
14	Magnetic Levitation Trains (Maglev): Introduction to Maglev and its history, advantages and disadvantages of Maglev compared to conventional trains
15	Magnetic Levitation Trains (Maglev): Principles of operation for Maglev systems, Electromagnetic Suspension (EMS) technology in Maglev, Electrodynamic Suspension (EDS) technology in Maglev, Inductrack technology in Maglev, Comparison of different suspension technologies
16	Magnetic Levitation Trains (Maglev): Maglev system in Germany (Transrapid), Maglev systems in Japan (HSST and JR Central).

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