Mechatronics Engineering

Educational Objectives

Mechatronics engineering is a multidisciplinary field of science that includes a combination of mechanical engineering, electrical engineering and control engineering. Rather than embrace traditional divisions of engineering as distinct entities, this is a degree that embraces the interdisciplinary area of mechanical engineering, control engineering and software development, especially for controlling sophisticated smart machines. Mechatronics engineering program teaches students to design and build computer controls for mechanical systems and machines like hybrid vehicles and robots. Additionally, the bachelor's program combines advanced engineering studies with projects that provide real-world experience in a variety of technologies and fields.

Core Courses

1. Common basic courses
Calculus, Physics, Chemistry, Linear Algebra, Probability and Statistics, Computer Science and Programming

2. Specialized basic courses
Theoretical Mechanics, Mechanics of Materials, Analog Electronics, Principle of Digital Logic and CPU, Theory of Machines and Mechanisms, Machine Design, Microprocessor Systems and Assembly Language, Signals and Systems

3. Specialized courses
Progress on the Discipline of Robotics, Introduction to Robotics, Innovation Practice-Mechatronic Systems, Innovation Practice-Intelligent Robots, Mechatronic Control Technology, Sensing and Testing Technology, Digital Image Processing, Computer Software Practice-Mechatronics

Program Outcomes

Students graduate with unique abilities in the full spectrum of smart machine design. Among the skills acquired is the development of autonomous systems such as self-operating robots, vehicles, as well as a thorough knowledge of industrial automation.
The graduates are able to solve the mechanical and electrical system engineering problem and to communicate effectively with the industry peers and the social public communication, including designing documents and writing reports, giving presentations and responding to commands. Furthermore, the graduates will have a certain international vision and communication ability in a cross-cultural circumstances.

Duration and Degree

4 years, Bachelor Degree of Engineering in Mechatronics Engineering

Curriculum

Semester 1			Credits
100172103	工科数学分析 I	Mathematical Analysis for Engineering	6
101190003	大学化学 C	General Chemistry C	2
101080081	计算机技术与编程	Computer Science and Programming	3
100245105	国际交流英语 I	International English Communication I	2
100230057	知识产权法基础	Practical Administrative Law	1
100270001	思想道德修养与法律基础	Ideological and Moral Cultivation and Basics of Law	3
100980001	军事理论	Military Theory	1
100980002	军事训练	Military Training	1.5
100320001	体育 I	Gym I	0.5
100160501	生命科学基础 A	Principle of Life Science	2
102172501	线性代数 A	Linear Algebra A	3.5
100930001	大学生心理素质发展	Psychological Quality Development of College Students	1
Total Hours			**26.5**

Semester 2			Credits
100172203	工科数学分析 II	Mathematical Analysis for Engineering	6
101037302	工程制图	Engineering Graphics	4
100270002	中国近现代史纲要	The History of Modern China	2
101180111	大学物理 I	College Physics I	4
100180116	物理实验 B I	Physics Laboratory B I	1
100245106	国际交流英语 II	International English Communication II	2
101080082	C 语言编程实践	C Programming Practice	1
101062219	电路分析基础实验 A	Electric Circuit Experiment A	1
101062102	电路分析基础 A	Fundamentals of Electric Circuit A	3.5
100320002	体育 II	Gym II	0.5
Elective	通识教育选修课	General Electives	2
Total Hours			**27**

Semester 3			Credits
101013001	理论力学	Theoretical Mechanics	4
100172003	概率与数理统计	Probability Theory and Mathematical Statistics	3
101180121	大学物理 II	College Physics II	4
100180125	物理实验 B II	Physics Laboratory B II	1
100172001	复变函数与积分变换	Complex Variables and Integral Transform	2
100051294	电子实习	Electronic Practice (Radio Installation)	1
100270003	马克思主义基本原理概论	Introduction to Basic Principles of Marxism	3
100320003	体育 III	Gym III	0.5
101062104	模拟电子技术基础 A	Analog Electronics A	3.5
100062203	模拟电子技术实验 A	Analog Electronics Experiment A	0.75
Elective	通识教育选修课	General Electives	2
Total Hours			**24.75**

Semester 4			Credits
101037304	机械原理	Theory of Machines and Mechanisms	3
101037305	工程材料与应用	Principle and Application of Engineering Materials	3
100270004	毛泽东思想和中国特色社会主义理论体系概论	Introduction to Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics	4
101014001	材料力学	Mechanics of Materials	3.5
100320004	体育 IV	Gym IV	0.5
101027101	机器人学科前沿与发展动态（全英文）	Progress on the Discipline of Robotics	1
102027102	创新创业实践-机电系统综合实践 I （第三学期上）	Innovation Practice - Mechatronic system I	2
102027103	微系统设计与制造	Micro-electro-mechanical System Design and Fabrication	2
Elective	通识教育选修课	General Electives	2
Total Hours			**21**

Semester 5			Credits
101037307	机械设计	Machine Design	3
101037303	科学研究与写作	Research Methods and Academic Writing	1
101037308	机械设计综合课程设计（英	Machine Design Project	2
101037313	制造技术基础训练（双语）	Basic Training of Manufacturing Technology	2
101063107	数字逻辑与 CPU	Digital Logic Circuit and CPU	5
101027104	信号与系统	Signals and Systems	3.5
102027105	创新创业实践-机电系统综合实践 II（第四学期上）	Innovation Practice - Mechatronic system II	2
100270005	社会实践	Social Practice	2
Total Hours			**20.5**

Semester 6			Credits
102027118	机电控制技术（双语）	Mechatronic Control Technology	3
102027119	传感与测试技术（双语）	Sensing and Testing Technology	3
101027120	微处理器与汇编语言（全英文）	Microprocessor Systems and Assembly Language	3
102027109	创新创业实践-智能机器人综合实践 I（第五学期上）	Innovation Practice - Intelligent Robots I	2
102027121	机器人学（双语）	Introduction to Robotics	2
102027123	高频电子电路（不开）	High Frequency Electronics	3
101027112	计算机软件实践（第五学期上）	Computer Software Practice-Mechatronics	2
101027122	宏观/微观系统中的流体力学（全英文） 微电子技术概论	Mechanics of Fluids in Macro-/Micro-systems	2
Total Hours			**18**

Semester 7			Credits
102027113	数字图像处理	Digital Image Processing	3
102027114	生产实习	Internship in Industry	3
102027115	创新创业实践-智能机器人综合实践 II（取消）	Innovation Practice - Intelligent Robots II	2
102027116	测量与虚拟仪器设计	Measurement and Virtual Instruments	3
Total Hours			**11**

Semester 8			Credits
102027117	毕业设计（论文）	Graduation Project (Thesis)	12
Total Hours			12
Total Credit Hours			**160.75**

Courses Descriptions

101013001 Theoretical Mechanics

This lecture course is based on the concepts of Newtonian (classical) mechanics and their application to engineered systems. This course introduces students to mechanical principles that are necessary to the understanding, analysis and design of mechanisms and machines. The two major parts of this course are: I. Statics and Structures; II. Kinematics and Dynamics. Topics include vector analysis, statics of rigid bodies, friction, kinematics of motion, work and energy, and dynamics of particles.
Prerequisite(s): Calculus and Differential Equation (I, II)

101014001 Mechanics of Materials

Mechanics of Materials is a branch of mechanics that studies the relationships between the external loads applied to a deformable body and the intensity of the internal forces acting within the body. The course covers the following topics: stress and strain in structural elements, mechanical properties of materials, extension, torsion and bending of members, thermal stress, static indeterminacy, stress and strain transformation. This course is one of the foundation stones for engineering science. It is designed as the standard introductory course for the mechanics of deformable bodies that every mechanical engineer must master. The course provides students the basic concepts and principles of strength of materials, gives an ability to calculate stresses and deformations of objects under external loadings, gives an ability to apply the knowledge of strength of materials on engineering applications and design problems and enables the students for all analysis and design courses in the mechanical engineering area. Laboratory experiments are required.
Prerequisite(s): Calculus and Differential Equation I, General Physics I.

101037304 Theory of Machines and Mechanisms

This course covers the basics of kinematics and dynamics of machinery. Specific topics include kinematic fundamentals; linkage synthesis; position, velocity and acceleration analysis; design and kinematic analysis of cams and gears; dynamic force analysis of linkage; static and dynamic balancing of mechanisms. Matlab is used to analyze and simulate mechanisms in the homework and project.
Prerequisite(s): Theoretical Mechanics.

101037307 Machine Design

This course is an introduction to the basic principles of modern engineering. It provides students with fundamental skills of engineering, and the ability to apply the theories of science to practice. The course focuses on the fundamentals and principles of basic mechanical elements, failure theories and design criteria, and structures of basic mechanical systems. The goal of the course is to learn how to design simple mechanical elements and systems.
Prerequisite(s): Engineering Graphics (I, II), Mechanics of Materials, Theory of Machines and Mechanisms.

101062104 Analog Electronics

This course covers diode, bipolar junction transistor, characteristics of field-effect transistor. Common-emitter amplifier, common-collector amplifier, common-base amplifier, analysis of Q-point, ac parameters analysis (voltage gain, input resistance and output resistance). Analysis of multistage amplifier circuits and differential amplifier circuits. Frequency response of Amplifier circuits. Effects of various negative feedback on amplifiers, estimation of closed loop gain. Virtual short and virtual open in the linear circuits of operational amplifiers. Analysis of various wave generating circuits. Construction and analysis of power suppliers.
Prerequisite(s): General Physics (I, II), Fundamentals of Electric Circuit Analysis

102027101 Progress on the Discipline of Robotics

This course is a required professional course towards junior students. Scientists from different research fields are invited to give lectures about the frontier and development of the industry. The purpose of this course is to equip the students with international perspective, and familiarize the students with the latest development and the advantages of the industry.

102027102 Innovation Practice - Mechatronic Systems I

The course was developed in accordance with the characteristics of Mechatronics Engineering. It is an open, innovative practice course in combination with the features of robotics. The students are guided to know the components and the design of mechatronic systems, grasp basic knowledge of common tools to design, install, debug the mechanical and electrical system. The course lays the foundation for the follow-up courses of study and application, at the same time, cultivates the students' practical ability to solve specific problems.

102027103 Micro-electro-mechanical System Design and Fabrication

Lecture topics include: advanced material properties, microfabrication technologies, structural behaviors, sensing methods, actuation methods, energy harvesting methods, micro fluid flow and amplifiers feedback systems. Students will work in team to design a variety of types (e.g. optical MEMS, inertial sensors) of microsystems (sensors, actuators, and sensing/control systems), in accordance with a set of performance specifications (e.g. sensitivity), in a realistic microfabrication process. Modeling and simulation will be emphasized during the design process.

102027104 Signals and Systems

The concepts of signals and systems arise in a wide variety of fields, and the ideas and techniques associated with these concepts play an important role in such diverse areas of science and technology as communications, aeronautics and astronautics, circuit design. The subject of signals and systems include the concepts of signals and systems, time-domain analysis for continuous-time systems, time-domain analysis for discrete-time systems, Fourier analysis for continuous-time signals, Fourier analysis for discrete -time signals, Fourier analysis for continuous-time and discrete -time systems, the Laplace transform and analysis for continuous-time systems, the z-transform and analysis for discrete -continuous-time systems.

102027105 Innovation Practice – Mechatronic Systems II

According to the characteristics of mechanical electronic engineering in our school, a professional practice of open innovation course, electromechanical system is established combined with features of robotics. We guide students to master the electromechanical device design and understand the process of research and development, basic principle and method of use of test equipment, and then to cultivate the innovative design ability. The course enable students to have the basic capabilities of design, installation, debugging mechanical and electrical system, lay the foundation for follow-up courses of study and application. At the same time cultivate the abilities of data collection, analysis and interpretation for students.

102027106 Mechatronic Control Technology

The course introduces the design of feedback control systems, properties and the advantages of feedback systems, time-domain and frequency-domain performance measures, stability and degree of stability. It also covers root locus method and frequency-domain design. By learning this course, the students are required to master the basic concepts and principles of the control system analysis and design, to develop the problem-solving skills and feedback control thinking, to lay massive foundation for further study and future career.

102027107 Sensing and Testing Technology

This course is a foundation course of weapon system engineering, mechanical and electrical engineering. This course is to explore the static and dynamic characteristics, the basic principle,

performance and usage of some typical sensors. Combining with the application of weapon system engineering, the students will master the test system analysis and design method for the specific test.

102027108 Microprocessor Systems and Assembly Language

The objective of this course is to acquaint students with the principle of microprocessors, including the structure of processors and their operational principle and to familiarize students with the assembly instructions and interface technologies. Students will be able to program the assembly language to solve some practical problems and grasp the method to control the microcomputer. The main topics of course are microprocessor structure and assembly language application. The structure of microprocessor is introduced first and on the basis of this, assembly instructions are studied (this part is emphasized). Then the programming methods are expounded respectively, including simple program, branched program, loop program and subprogram. The last part of this course is the interface technology, mainly deals with the application of parallel and serial interfaces.

102027109 Innovation Practice - Intelligent Robots I

Robotics is an advanced subject which is highly integrated and cross cutting. Through the course of learning, the students will be familiar with the basic robot technology and the development of the situation, and lay a good foundation for the future in intelligent automation technology and equipment system design and manufacturing. Through the course of learning and practice, so that students master the knowledge of robot system, including servo, motion control and system structure design techniques and basic theory.

Robot is a typical machine, electricity, drive, control, measurement, integrated device, it is not a simple combination of mechanical, electronic, but an organic combination of mechanical, electronic, drive, control, etc. Through the practical study of this course, we mobilize the students' initiative, stimulate students' creative thinking, students will learn the literature search, to sum up the analysis and decomposition of key technologies, and try to refine the scientific issues.

102027110 Introduction to Robotics

Robot is an archetypical mechatronic system that represents tremendous achievements in modern science and technology. This course is to explore the basic principles and techniques of robotics, which may involve robot structures, computer science, automatic control theory, sensor technology, bionics and artificial intelligence. It is an elective course for juniors and seniors major in mechatronics, and will lead students to profound understanding of mechatronical system.

102027111 High Frequency Electronics

This course is an introduction to high frequency (tens-hundreds MHz range) circuit design and analysis techniques, with particular emphasis on applications for sensing systems. A laboratory experience provides hands-on exposure to typical high-frequency measurement techniques. Students will develop an enhanced understanding of circuit design and analysis principles as applied to high frequency circuits, as well as gain familiarity with design techniques for both hand analysis and computer-aided design.

102027112 Computer Software Practice-Mechatronics

This course is to train the ability of the students to analyze and solve engineering problem, through learning computer software and practice related to the major of mechatronics. Students should get familiar with Matlab platform and learn to visually demonstrate the whole procedure of how to solve the problem. Through learning Alltium Designer, students should know how to develop the digital products and try to design some kinds of the products related to their research. Finally, Students should know how to logically solve the engineering problem and innovative in their research process.

102027113 Digital Image processing

This course is to explore the fundamentals of digital image processing. The basic topics of the

representation of digital image, spatial filtering, intensity transform, fourier transform, geometric transformation, color and color transform, and morphological image processing will be introduced. Other topics related to image restoration, image registration, image segmentation and object recognition will NOT be included. The basic operation of Matlab will be presented. Image processing using Matlab image processing toolbox will also be introduced.

102027115 Innovation Practice - Intelligent Robots II

Robotics is an advanced subject which is highly integrated and cross cutting. Robot technology is a set of mechanics, biology, anthropology, computer science and engineering, control theory and control engineering, electronic engineering, artificial intelligence, intelligent sensing, sociology and other disciplines, which is a strongly comprehensive new technology. Through the practicing and learning of this course, we mobilize the initiative of students, inspire the students' innovative thinking, students will learn to literature query, summary analysis and key technology of decomposition, try to refine scientific problems .We guide the students to construct and developed a robotic system, deepen the understanding of students on robotics and system, cultivate and improve the students' comprehensive use of basic theory and professional knowledge in the innovation ability.

102027116 Measurement and Virtual Instruments

The main goal of this course is for students to learn applications of programming, signal transduction, data acquisition, data analysis, signal processing used in the design of mechanical and electronical instrumentation. The software package LabVIEW has become a standard in academic and industrial environments for data acquisition, interfacing of instruments and instrumentation control. Students in this course will learn LabVIEW as a tool for the design of computer-based virtual instruments, which add software-based intelligence to sensors and basic laboratory bench devices.

Course Syllabus

101013001 Theoretical Mechanics

Lecture Hours: 64
Laboratory Hours: 0
Credits: 4

Prerequisite(s): Calculus and Differential Equation (I, II), General Physics (I, II), General Physics Lab B (I, II)

Course Description:
This lecture course is based on the concepts of Newtonian (classical) mechanics and their application to engineered systems. This course introduces students to mechanical principles that are necessary to the understanding, analysis and design of mechanisms and machines. The two major parts of this course are: I. Statics and Structures; II. Kinematics and Dynamics. Topics include vector analysis, statics of rigid bodies, friction, kinematics of motion, work and energy, and dynamics of particles.

Course Outcomes:
The objectives of this course are: to give the students the ability to analyze the motion of an object; to be able to perform a kinematic analysis as well as a kinetic analysis of an object experiencing either particle motion or planar motion.

Course Content:
Lectures and Lecture Hours:

1. General Principles 2
   - Mechanics
   - Fundamental Concepts
   - Units of Measurement
   - The International System of Units
   - Numerical Calculations
2. Force System Resultants 6
   - Moment of a Force–Scalar Formulation
   - Cross Product
   - Moment of a Force–Vector Formulation
   - Principle of Moments
   - Moment of a Force about a Specified Axis
   - Moment of a Couple
   - Simplification of a Force and Couple System
   - Further Simplification of a Force and Couple System
   - Reduction of a Simple Distributed Loading
3. Equilibrium of a Rigid Body 6
   - Conditions for Rigid-Body Equilibrium
   - Free-Body Diagrams
   - Equations of Equilibrium
   - Free-Body Diagrams
   - Equations of Equilibrium
   - Constraints and Statical Determinacy

4. Structural Analysis 6
   - Simple Trusses
   - The Method of Joints
   - Zero-Force Members
   - The Method of Sections
   - Space Trusses
   - Frames and Machines
5. Friction 4
   - Characteristics of Dry Friction
   - Problems Involving Dry Friction
   - Wedges
   - Frictional Forces on Screws
   - Frictional Forces on Flat Belts
   - Frictional Forces on Collar Bearings, Pivot Bearings, and Disks
   - Frictional Forces on Journal Bearings
   - Rolling Resistance
6. Virtual Work 4
   - Definition of Work
   - Principle of Virtual Work
   - Principle of Virtual Work for a System of Connected Rigid Bodies
   - Conservative Forces
   - Potential Energy
   - Potential-Energy Criterion for Equilibrium
   - Stability of Equilibrium Configuration
7. Kinematics and Kinetics of a Particle 4
   - General Curvilinear Motion
   - Curvilinear Motion： Rectangular Components
   - Curvilinear Motion： Normal and Tangential Components
   - Curvilinear Motion： Cylindrical Components
   - Newton's Laws of Motion
   - The Equation of Motion
   - Equation of Motion for a System of Particles
   - Equations of Motion： Rectangular Coordinates
   - Equations of Motion： Normal and Tangential Coordinates
   - Equations of Motion： Cylindrical Coordinates
   - Central-Force Motion and Space Mechanics
8. Planar Kinematics of a Rigid Body 6
   - Rigid Body Motion
   - Translation
   - Rotation about a Fixed Axis
   - Absolute General Plane Motion Analysis
   - Relative Motion Analysis: Velocity
   - Instantaneous Center of Zero Velocity
   - Relative Motion Analysis: Acceleration
   - Relative Motion Analysis Using Rotating Axes
9. Planar Kinetics of a Rigid Body：Force and Acceleration 6
   - Moment of Inertia
   - Planar Kinetic Equations of Motion
   - Equations of Motion：Translation
   - Equations of Motion：Rotation About a Fixed Axes
   - Equations of Motion：General Plane Motion
10. Planar Kinetics of a Rigid Body：Work and Energy 4

- Kinetic Energy
- The Work of a Force
- The Work of a Couple
- Principle of Work and Energy
- Conservation of Energy

11. Planar Kinetics of a Rigid Body： Impulse and Momentum 4
    - Linear and Angular Momentum
    - Principle of Impulse and Momentum
    - Conservation of Momentum
    - Eccentric Impact
12. Three Dimensional Kinematics of a rigid Body 4
    - Rotation about a Fixed Point
    - The Time Derivative of a Vector Measured from Either a Fixed and Translating Rotating System
    - General Motion
    - Relative Motion Analysis Using Translating and Rotating Axes
13. Three Dimensional Kinetics of a Rigid Body 4
    - Moments and Products of Inertia
    - Angular Momentum
    - Kinetic Energy
    - Equations of Motion
    - Gyroscopic Motion
    - Torque Free Motion
14. Vibrations 4
    - Undamped Free vibration
    - Energy Methods
    - Undamped Forced Vibration
    - Viscous Damped Free Vibration
    - Viscous Damped Forced Vibration
    - Electrical Circuit Analogs

Grading:

Homework	5%
Inclass Quizzes	5%
1 Midterm Exams	20%
Final	70%

Text & Reference Books: Textbook:

Russell C. Hibbeler, *Engineering Mechanics: Combined Statics & Dynamics*, 12th edition, Prentice Hall; May 3, 2009

References:

1) Bedford and Fowler. *Engineering Mechanics: Statics*, 5th edition, Prentice Hall

2) J. L. Meriam and L. G. Kraige (1997) *Engineering Mechanics: Dynamics*, 4th edition, John Wiley & Sons, New York.

3) Pytel, Andrew and Jaan Kiusalaas (1999) *Engineering Mechanics: Dynamics*, 2nd edition, Brooks/Cole Publishing, Pacific Grove, California.

4) Ginsberg, Jerry H. (1995) Advanced Engineering Dynamics, 2nd edition, Cambridge University Press, New York.

101014001 Mechanics of Materials

Lecture Hours: 48
Laboratory Hours: 8
Credits: 3.5
Prerequisite(s): General Physics I, Calculus and Differential Equation I

Course Description:
Mechanics of Materials is a branch of mechanics that studies the relationships between the external loads applied to a deformable body and the intensity of the internal forces acting within the body. The course covers the following topics: stress and strain in structural elements, mechanical properties of materials, extension, torsion and bending of members, thermal stress, static indeterminacy, stress and strain transformation. This course is one of the foundation stones for engineering science. It is designed as the standard introductory course for the mechanics of deformable bodies that every mechanical engineer must master. The course provides students the basic concepts and principles of strength of materials, gives an ability to calculate stresses and deformations of objects under external loadings, gives an ability to apply the knowledge of strength of materials on engineering applications and design problems and enables the students for all analysis and design courses in the mechanical engineering area. Laboratory experiments are required.

Course Outcomes:
After completing this course, a student should be able to:
1. Calculate and understand the concepts of stress and strain;
2. Calculate, describe, and estimate external loadings, including axial load, shear force, bending, and torsion, and the resulting deformations and internal stresses associated with these externalloadings;
3. Calculate and describe the internal stresses and deformations that result in combined loading conditions;
4. Calculate internal stresses and strains through the application of stress transformation equations and Mohr's circle;
5. Design components to meet desired needs in terms of strength and deformation.
6. Foster effective mathematical and graphical communication skills.
7. Cultivate ethical engineering decisions

Course Content:
Lectures and Lecture Hours:
1. Stress 4
   - Equilibrium of a Deformable Body
   - Stress
   - Average Normal Stress in an Axially Loaded Bar
   - Average Shear Stress
   - Allowable Stress
2. Strain 2
   - Deformation
   - Strain
3. Mechanical Properties of Materials 4
   - The Tension and Compression Test
   - The Stress-Strain Diagram
   - Stress-Strain Behavior of Ductile and Brittle Materials
   - Hooke's Law
   - Strain Energy
   - Poisson's Ratio

- The Shear Stress-Strain Diagram

4. Axial Load 4
   - Saint-Venant's Principle
   -Elastic Deformation of Axially Loaded Member
   - Principle of Superposition
   - Statically Indeterminate Axially Loaded Member
   - The Force Method of Analysis for Axially Loaded Members
   - Thermal Stress
   - Stress Concentration
5. Torsion 4
   - Torsion Deformation of a Circular Shaft
   - The Torsion Formula
   - Power Transmission
   - Angle of Twist
   - Statically Indeterminate Torque-Loaded Members
   - Stress Concentration
6. Bending 6
   - Shear and Moment Diagrams
   - Graphical Method for Constructing Shear and Moment
   - Bending Deformation of a Straight Member
   - The Flexure Formula
   - Unsymmetric Bending
   -*Composite Beams
   - Stress Concentrations
7. Transverse Shear 6
   - Shear in Straight Members
   - The Shear Formula
   - Shear Stresses in Beams
   - Shear Flow in Built-up Members
   - Shear Flow in Thin-walled Members
8. Combined Loadings 4
   - Thin-Walled Vessels
   - State of Stress Caused by Combined Loadings
9. Stress and Strain Transformation 6
   - Plane-Stress Transformation
   - General Equations of Plane-Stress Transformation
   - Principal Stresses and Maximum In-Plane Shear Stress
   - Mohr's Circle-Plane Stress
   - Absolute Maximum Shear Stress
   - Plain Strain
   - General Equations of Plain-Strain Transformation
   - *Absolute Maximum Shear Strain
   - Strain Rosettes
   - Material-Property Relationships
   - *Theories of Failure
10. Deflections of Beams and Shafts 8
   - The Elastic Curve
   - Slope and Displacement by Integration
   - Slope and Displacement by the Moment-Area Method
   - Method of Superposition
   - Statically Indeterminate Beams and Shafts-Method of Integration
   - Statically Indeterminate Beams and Shafts-Moment-Area Method
   - Statically Indeterminate Beams and Shafts-Method of Superposition

Laboratories and Laboratory Hours:

1. Low Carbon Steel Tensile Test 2
2. Gray Cast Iron Tensile Test 2
3. Deflection Measurement for Metallic Beams 2
4. Deformation Measurement for Metallic Beam under Combined Bending and Torsion Loadings 2

Grading:

Homework	20%
Lab Report	10%
Final	70%

Text & Reference Books:

1) R. C. Hibbeler, *Mechanics of Materials*, 5th edition, 2004, ISBN 7-04-014008-X.
2) James M. Gere and Stephen P. Timoshenko, *Mechanics of Materials*, 4th edition, 1997, ISBN 0-534-95102-3.

101037304 Theory of Machines and Mechanisms

Lecture Hours: 42
Laboratory Hours: 6
Credits: 3
Prerequisite(s): Theoretical Mechanics

Course Description:
This course covers the basics of kinematics and dynamics of machinery. Specific topics include kinematic fundamentals; linkage synthesis; position, velocity and acceleration analysis; design and kinematic analysis of cams and gears; dynamic force analysis of linkage; static and dynamic balancing of mechanisms. Matlab is used to analyze and simulate mechanisms in the homework and project.

Course Outcomes:
Upon completing this course, students are able to:
1. Synthesize a mechanism using graphical and analytical methods for a given path, motion or function generation task.
2. Perform kinematic analysis to obtain position, velocity, and acceleration of a designed mechanism.
3. Perform kinetic analysis to determine dynamic forces of a designed mechanism.
4. Design and analyze cam and gear mechanisms.
5. Use Matlab to analyze and simulate mechanisms.

Course Content:
Lectures and Lecture Hours:

1. Introduction 2
   - Purpose
   - Kinematics and kinetics
   - Mechanisms and machines
   - Design process
2. Kinematics fundamentals 4
   - Mechanism terminology
   - Kinematic diagrams
   - Kinematic inversion
   - Degrees of freedom or mobility
   - The four- bar mechanism
   - The slider- crank mechanism
3. Position and displacement analysis 2
   - Introduction
   - Position analysis
   - Displacement analysis
   - Limiting position
   - Transmission angle
4. Mechanism design 3
   - Introduction
   - Time ratio
   - Design of slider- crank mechanisms
   - Design of crank - rocker mechanisms
   - Two-position synthesis
   - Three-position synthesis
5. Velocity analysis 4
   - Introduction

- Relative velocity method
- Instant centre method
- Graphical velocity analysis
- Analytical velocity analysis

6. Acceleration analysis 4
   - Introduction
   - Relative acceleration method
   - Graphical acceleration analysis
   - Analytical acceleration analysis
7. Cams: design and kinematic analysis 9
   - Introduction
   - Type of cams
   - Type of followers
   - Prescribed follower motion
   - Follower motion schemes
   - Graphical disk cam profile design
   - Pressure angle
   - Design limitation
   - Design project: computer simulation of cam mechanisms
8. Gears: design and kinematic analysis 10
   - Introduction
   - Type of gears
   - Spur gear terminology
   - Involute tooth profile
   - Standard gears
   - Relationships of gears in mesh
   - Spur gear kinematics
   - Spur gear selection
   - Helical gear kinematics
   - Worm gear kinematics
   - Gear trains
   - Planetary gear trains
9. Dynamic force analysis 4
   - Introduction
   - Force analysis of the four-bar linkage
   - Force analysis of the slider- crank linkage
   - Balancing of rigid rotors

Laboratories and Laboratory Hours:

1. Structure analysis and kinematic diagram drawing for mechanism 2
2. Experiment on gear generating 2
3. Experiment on dynamic balance system of rigid rotor 2

Grading:

Homework	20%
Group Presentation	5%
Midterm Exams	20%
Project	20%
Final	35%

Text & Reference Books:

1) Robert L. Norton, *Design of Machinery: An Introduction to Synthesis and Analysis of Mechanisms and Machines*, 4th Edition, 2008, ISBN 978-0-07-312158-1.
2) David H. Myszka, *Machines and Mechanism: Applied Kinematic Analysis*, 4th Edition, 2012, ISBN 978-0-13-215780-3.

101037307 Machine Design

Lecture Hours: 42
Laboratory Hours: 6
Credits: 3

Prerequisite(s): Engineering Graphics (I, II), Mechanics of Materials, Theory of Machines and Mechanisms

Course Description:
This course is an introduction to the basic principles of modern engineering. It provides students with fundamental skills of engineering, and the ability to apply the theories of science to practice. The course focuses on the fundamentals and principles of basic mechanical elements, failure theories and design criteria, and structures of basic mechanical systems. The goal of the course is to learn how to design simple mechanical elements and systems.

Course Outcomes:
After completing this course, the student should be able to:
1. Understand the failure modes and design theories of typical mechanical elements.
2. Master the design criteria of basic mechanical elements.
3. Know well the typical structures of basic mechanical elements.
4. Know well the design process of typical mechanical elements.
5. Design basic mechanical elements.
6. Design simple mechanical systems.

Course Content:
Lectures and Lecture Hours:

1. Introduction to machine design 2
   - Mechanical engineering design
   - Basic concepts
   - Design tools and resources
2. Failure theories 4
   - Failures resulting from static loading
   - Fatigue failures resulting from variable loading
3. Friction, lubrication and wear 4
   - Basic friction theory and contact
   - Lubrication
   - Wear process
4. Transmission elements – Belt drive 4
   - Introduction to belt drives
   - Working principle of typical belt drives
   - Belt drive design
5. Transmission elements – gear trains 6
   - Force analysis of gearing
   - Typical failure modes of gears
   - Theory of surface contact fatigue strength
   - Theory of tooth root bending fatigue strength
   - Design of gear set and parameters determination
   - Structure of gears
6. Transmission elements – Worm gears 2
   - Worm-gear analysis
   - Designing a Worm-gear Mesh
7. Shafts and axles 4
   - Introduction

- Geometric and strength constraints
- Shaft materials
- Shaft design

8. Rolling element bearings 4
   - Bearing types
   - Bearing life
   - Combined radial and thrust loading

- Mounting and enclosure

9. Fluid-film bearings 4
   - Structure of journal bearing and materials
   - Hydrodynamic theory
   - Designing fluid-film journal bearing
   - Designing boundary-lubricated bearing
10. Friction elements: clutches and brakes 2
   - Clutches
   - Brakes
11. Connecting elements 4
   - Tread standards and definitions
   - Preload and looseness-proof
   - Force analysis
   - Bolt strength
12. Other elements and review 2

Laboratories and Laboratory Hours:

1. Belt drive	2
2. Shaft assembly	2
3. Sliding bearing	2

Grading:

Homework	15%
Discussions and presentations	15%
Quizzes in class	10%
Lab performance	10%
Final	50%

Text & Reference Books:

1) Robert L. Norton. *Machine design, an integrated approach.* 4th Edition. ISBN: 0-13-612370-8, Upper Saddle River: Pearson Education Inc., 2010.
2) Shigley, Joseph, Charles Mischke, and Richard Budynas. *Mechanical Engineering Design*. Boston, MA: McGraw-Hill, 2003. ISBN: 9780072921939

101062104 Analog Electronics

Lecture Hours:	**54**
Laboratory Hours:	**0**
Credits:	**3.5**
Prerequisite(s):	**General Physics (I, II), Fundamentals of Electric Circuit Analysis**

Course Description:

This course covers diode, bipolar junction transistor, characteristics of field-effect transistor. Common-emitter amplifier, common-collector amplifier, common-base amplifier, analysis of Q-point, ac parameters analysis (voltage gain, input resistance and output resistance). Analysis of multistage amplifier circuits and differential amplifier circuits. Frequency response of Amplifier circuits. Effects of various negative feedback on amplifiers, estimation of closed loop gain. Virtual short and virtual open in the linear circuits of operational amplifiers. Analysis of various wave generating circuits. Construction and analysis of power suppliers.

Course Outcomes:

After completing this course, a student should be able to master the fundamental theory, concepts, analysis methods and techniques of the analog electronics. Details are listed in the following:

1. Fundamental concepts, characteristics and parameters of semiconductor devices.
2. Theory and analysis of fundamental amplifier circuits.
3. Characteristics and analysis of feedback circuits.
4. Analysis and applications of linear and nonlinear operational amplifier circuits.
5. Analysis and design of wave generation circuits and power suppliers.
6. Simulation methods of amplifier circuits using Multisim2001.

Course Content:

Lectures and Lecture Hours:

1. Semiconductor Materials and Diodes 2
   - Semiconductor Materials
   - Semiconductor Diodes
2. Bipolar Junction Transistor (BJT) and Basic BJT Amplifiers 8
   - Bipolar Junction Transistor
   - Fundamental Theory and Performance Evaluation of BJT Amplifiers
   - Graphical Methods for BJT Amplifier Analysis
   - Small-signal Equivalent Circuits for BJT Amplifier Analysis
   - Other Basic BJT Amplifiers
   - Compound Amplifiers
3. Field-Effect Transistor (FET) and Basic FET Amplifiers 4
   - Field-Effect Transistor
   - Basic FET Amplifiers
4. Multistage Amplifiers and Operational Amplifiers 6
   - Connection and Analysis of Multistage Amplifiers
   - Differential Amplifier Circuits
   - Operational Amplifier Circuits
5. Power Amplifiers 4

- Introduction – Definitions and Amplifier Types
- Class-A Power Amplifiers
- Push-Pull Complementary Power Amplifiers
- Power Amplifier Circuits
- Power Transistor Heat Sinking

6. Amplifier Frequency Response 3
   - Introduction
   - Frequency Response of RC Circuits
   - High-Frequency Equivalent Models of BJT and FET
   - Frequency Response of Single Transistor Amplifiers
   - Frequency Response of Multistage Amplifiers
   - Time-domain Response
7. Feedback in Amplifier Circuits 6
   - Concepts and Types of Feedback
   - Block Diagram of Feedback Amplifiers
   - Effects of Negative Feedback on Amplifiers
   - Analysis of Negative Feedback Amplifiers
   - Right Connection of Feedback in Amplifier Circuits
   - Oscillation in Negative Feedback Amplifiers and Its Removal Methods
8. Linear Applications of Operational Amplifiers 6
   - Introduction
   - Basic Arithmetic Circuits
   - Logarithm and Exponent Circuits
   - Multiplication and Division Circuits
   - Effects of Real Operational Amplifiers on Arithmetic Circuits
   - Active Filter Circuits
   - Switched Capacitor Filter Circuits
9. Oscillators and Nonlinear Applications of Operational Amplifiers 8
   - Sine Wave Oscillator Circuit
   - Voltage Comparator
   - Non Sine Wave Generating Circuit
10. DC Power Supply 5
    - Rectification Circuits
    - Filter Circuits
    - Regulator Circuits
    - Integrated Regulator and Its Applications
11. EDA Technology and Programmable Analog Devices 2

Grading:

Homework	10%
Inclass Quizzes	10%
Project	10%
Final	70%

Text & Reference Book:

Donald A. Neamen, *Microelectronics-Circuits Analysis and Design*, 3rd edition, 2007, McGraw Hill Press and Tsinghua University Press.

102027101 Progress on the Discipline of Robotics

Lecture Hours: **16**
Laboratory Hours: **0**
Credits: **1**

Prerequisite(s): Mechanical Design, Digital Electronics, Analog Electronics

Course Description:
This course is a required professional course towards junior students. Scientists from different research fields are invited to give lectures about the frontier and development of the industry. The purpose of this course is to equip the students with international perspective, and familiarize the students with the latest development and the advantages of the industry.

Course Outcomes:
After completing this course, a student should be able to:
1. Have international perspective of robotics
2. Be familiar with the latest developments of mechanical engineering

Course Content:
Lectures and Lecture Hours:

1.	Introduction to legged robots	2
2.	Introduction to micro-nano robots	2
3.	Introduction to medical robots	2
4.	Introduction to space robots	2
5.	Introduction to rehabilitation robots	2
6.	Introduction to rescue robots	2
7.	Introduction to human-robot interface	2
8.	Introduction to unmanned systems	2

Grading:

Classroom performance	40%
Report	60%

Text & Reference Book:
1) Bruno Siciliano, Oussama Khatib. Handbook of Robotics, Springer, 2008
2) Ahmed A. Shabana. Dynamics of Multibody Systems, Cambridge, 2005
3) Toshio Fukuda, Tomohide Niimi and Gero Obinata, Micro-Nano Mechatronics, Intech, 2013.
4) Toshio Fukuda, Yasuhisa Hasegawa, Kosuke Sekiyama and Tadayoshi Aoyama, Multi-Locomotion Robotic Systems, Springer, 2012.

102027102 Innovation Practice – Mechatronic systems I

Lecture Hours: **10**
Laboratory Hours: **54**
Credits: **2**

Prerequisite(s): a) Engineering drawing b) programming language C

Course Description:
The course was developed in accordance with the characteristics of Mechatronics Engineering. It is an open, innovative practice course in combination with the features of robotics. The students are guided to know the components and the design of mechatronic systems, grasp basic knowledge of common tools to design, install, debug the mechanical and electrical system. The course lays the foundation for the follow-up courses of study and application, at the same time, cultivates the students' practical ability to solve specific problems.

Course Outcomes:
After completing this course, a student should be able to:
1. Understand the components of electromechanical system and its design methods.
2. Understand the commonly used components of electromechanical system.
3. Understand the mechanical design software, electric driver and sensors, as well as the simple performance analysis and improvement of electromechanical system.
4. Understand the motor driver control technology and can use the single chip to control multiple motors.
5. Understand the principle of the angle sensors, displacement sensors and visual sensors.

Course Content:
Lectures and Lecture Hours:
1. Introduction 2
   - 1.1 Present situation and trend of electromechanical system technology development
   - 1.2 Introduction the commonly used components of electromechanical system
2. Electromechanical system 6
   - 2.1 Commonly used software for the electromechanical system
   - 2.2 Mechanical parts design and processing for the electromechanical system
   - 2.3 Electromechanical control technology for the electromechanical system
   - 2.4 Motor driver control technology for the electromechanical system
   - 2.5 Peripheral sensing detection for the electromechanical system
3. Data reorganization and defense 2
   - 3.1 Data collection, and preparation of documents
   - 3.2 Electromechanical system display
   - 3.3 Defence

Laboratories and Laboratory Hours: 54
Students are divided into several teams. Each team selects a very simple electromechanical system to design and build. Each team needs to give a presentation weekly. The team members make turns inside. Finally, each team should complete its own electromechanical system and show it in the final defence. The procedure is guided by the teacher.

Grading:

Presentation	20%
Physical display	70%
Performance in class	10%

Text & Reference Book:

102027103 Micro-electro-mechanical System Design and Fabrication

Lecture Hours: 24
Laboratory Hours: 8
Credits: 2

Prerequisite(s): 1. Pass the examination of College Physics
2.Complete course of Digital Fundamentals of Electronic Technology and Analog Fundamentals of Electronic Technology

Course Description:
Lecture topics include: advanced material properties, microfabrication technologies, structural behaviors, sensing methods, actuation methods, energy harvesting methods, micro fluid flow and amplifiers feedback systems. Students will work in team to design a variety of types (e.g. optical MEMS, inertial sensors) of microsystems (sensors, actuators, and sensing/control systems), in accordance with a set of performance specifications (e.g. sensitivity), in a realistic microfabrication process. Modeling and simulation will be emphasized during the design process.

Course Outcomes:
After completing this course, a student should be able to:
1 Understand the basic knowledge of micro-electro-mechanical system.
2. Design, Molding and simulating the micro system projects, such as sensors, actuators and energy harvesters.
3. Mastering micro-system fabrication technology, such as photolithography, etching, deposition.

Course Content:
Lectures and Lecture Hours:
1. Introduction 2
   - Definitions of micro-electro-mechanical system technology
   - History of MEMS technology
   - Typical applications of MEMS technology
   - Development trend of MEMS technology
2. Principles of MEMS system 4
   - Capacitive effect
   - Piezoresistive effect
   - Piezoelectric effect
   - Electrostatic effect
   - Pyroelectric effect
   - Photoelectric effect
3. Typical MEMS sensors and applications 4
   - Force MEMS sensor
   - Vibration MEMS sensor
   - Chemical MEMS Sensor
   - Bio MEMS sensor
   - Optical MEMS sensor
4. Typical MEMS actuators and applications 4
   - Electrostatic MEMS actuators
   - Piezoelectric MEMS actuators
   - Thermal MEMS actuators
5. MEMS system design, molding and simulation 4
   - Principles of MEMS system design
   - Approaches for MEMS system design
   - Approaches for molding

- Approaches for simulation

6. Concept of MEMS system fabrication 2
   - Characteristics of MEMS system fabrication
   - Fabrication capability of MEMS and CMOS
   - Procedure of Silicon-based MEMS system fabrication
   - Procedure of polymer-based MEMS system fabrication
7. Silicon-based MEMS fabrication 6
   - Photolithography process
   - Etching process
   - Deposition process
8. Non Silicon-based MEMS fabrication and package 2
   - LIGA techniques
   - Special machining techniques
   - Package techniques

Laboratories and Laboratory Hours:

1. Typical MEMS sensors and actuators design, molding and simulation 6
2. Demonstrating experiments of vibration sensors 2

Grading:

1. Final examination 60%
2. Regular grades 40%
1) Attendance of class and laboratory 25%
2) Experiment report 15%
3. 5 points deduction if absence; 3 points deduction if not handing in experiment report

Text & Reference Book:

1) Wang J K, Microsystem design and fabrication [M]. Beijing Tsinghua Press. 2015.
2) Chang L. Microsystem Foundation [M]. Beijing mechanical engineering Press. 2013.

102027104 Signals and Systems

LectureHours: 48
Laboratory Hours: 8
Credits: 3.5
Prerequisite(s): Calculus and Differential Equation，Circuit Analysis，Fundmentals of Analog Electronics，Fundmentals of Digital Electronics

Course Description:
The concepts of signals and systems arise in a wide variety of fields, and the ideas and techniques associated with these concepts play an important role in such diverse areas of science and technology as communications, aeronautics and astronautics, circuit design. The subject of signals and systems include the concepts of signals and systems, time-domain analysis for continuous-time systems, time-domain analysis for discrete-time systems, Fourier analysis for continuous-time signals, Fourier analysis for discrete -time signals, Fourier analysis for continuous-time and discrete -time systems, the Laplace transform and analysis for continuous-time systems, the z-transform and analysis for discrete -continuous-time systems.

Course Outcomes:
The objectives of this course are: to make the students understand the concept of signals and system, to give the students the ability to process signals and analyze the function of the systems, learn to do the Fourier Transformation, Laplace Transformation and z Transformation.

Course Content:
Lectures and Lecture Hours:

1. Basic concepts of signals and systems 3
   - The concept of the signal and the waveform transformation, the basic continuous time signal and the discrete time signal
   - The concept of the system, system interconnection, characteristics and classification of systems
2. Time domain analysis of continuous time systems 6
   - The differential equation description of the system and its solution, zero input, zero state, unit impulse response
   - Solve the zero state response by using the convolution integral, the nature of the convolution integral and all its solution
   - Characterization of the unit impulse response and singular function of the system
3. Time domain analysis of discrete time systems 4
   - The description and solution of the differential equation of the system, zero input, zero state, unit impulse response
   - Solve the zero state response by using the convolution integral, the nature of the convolution integral and all its solution
   - Representing System by using unit sampling response, discrete time system simulation, and the deconvolution
4. The Continuous-Time Fourier Transform-- spectrum analysis of continuous time 5
   - Orthogonal function, continuous time Fourier series and its properties
   - Waveform symmetry and Fourier coefficient, spectrum of periodic signals and the effective bandwidth
   - The relationship between continuous time Fourier transform, Fourier transform and Fourier series
   - The properties and applications of Fourier transform, the power spectrum and energy spectrum of the signal
   - Brief introduction to the short time Fourier transform (STFT) and time domain analysis

5. Spectrum analysis of discrete time signal 6
   - Discrete time processing of continuous time signals, sampling theorem
   - Discrete time Fourier series (DFS) and its properties
   - Discrete time Fourier transform (DTFT) and its properties
6. Frequency domain analysis of continuous time and discrete time systems 6
   - Frequency response of continuous time system, Fourier analysis method, polar coordinate representation of frequency response
   - The non-distortion transmission condition of system, ideal filter, cascade, parallel structure
   - Frequency domain analysis of discrete time systems, the relationship between DFS and DTFT
7. Complex frequency domain analysis of continuous time system 6
   - Laplasse transform and its properties, Laplace pairs, Laplasse inverse transform
   - Single side Laplace transform and its properties, the complex frequency domain analysis method
   - The relationship between system function, Z transform and Laplace transform
8. Z transform and Z domain analysis of discrete time system 6
   - Z transform and its properties, Common Z transform pair, Z inverse transform
   - Unilateral Z transform and its properties, Complex frequency domain analysis method
   - System function, Relationship between Z transform and Laplace transform
9. Analysis of state variables of continuous time and discrete time systems 3
   - State and state variables, Method for establishing state equation

General review of the whole class (3 lecture hours)
Simulation Experiment (8 lecture hours)
Experimental items can be selected from the following:

(1) Time domain analysis of linear systems (2 lecture hours)
(2) Frequency domain analysis of continuous signals (2 lecture hours)
(3) Frequency domain analysis of continuous system (2 lecture hours)
(4) Z domain analysis of discrete systems (2 lecture hours)
(5) Fourier series representation of periodic signals (2 lecture hours)

Grading:

Homework	10%
Inclass Quizzes	10%
Experiment Report	10%
Final	70%

Text & Reference Books: Textbook:

William M. Siebert, *Circuits, Signals, and Systems*, 1st edition, MIT Press; September 24, 1985
References:

1) Alan V. Oppenheim. *Signals and Systems*, 2nd edition, PrenticeHall
2) John I. Molinder (2006) *Fundamentals of Signals and Systems*, 1st edition, Cambridge University Press.
3) Rawat, Tarun Kumar (2010) *Signals and Systems*, 1st edition, Oxford University Press,USA.
4) S.S. Haykin (2003) *Signals and Systems*, 2nd edition, John Wiley & Sons.

102027105 Innovation Practice - Mechatronic systems II

Lecture Hours: 10
Laboratory Hours: 54
Credits: 2
Prerequisite(s): a) Engineering drawing b) programming language C

Course Description:
According to the characteristics of mechanical electronic engineering in our school, a professional practice of open innovation course, electromechanical system is established combined with features of robotics. We guide students to master the electromechanical device design and understand the process of research and development, basic principle and method of use of test equipment, and then to cultivate the innovative design ability. The course enable students to have the basic capabilities of design, installation, debugging mechanical and electrical system, lay the foundation for follow-up courses of study and application. At the same time cultivate the abilities of data collection, analysis and interpretation for students.

Course Outcomes:
After completing this course, a student should be able to:
1. Understand the components of electromechanical system and its design methods.
2. Understand the thinking mode affecting the performance of electromechanical system.
3. Understand the working mechanism and design method, electric drive and control system, as well as the performance analysis and improvement of electromechanical system.
4. Briefly analyze the design of the system according to the requirements of electromechanical system, the selection and design of core technology parameters.
5. Propose the scheme of corresponding electromechanical system selection according to various functional requirements, analyze the factors affecting the performance of the system, propose different electromechanical system design and analysis of the mode of thinking.

Course Content:
Lectures and Lecture Hours:
1. Introduction 2
   - 1.1 Present situation and trend of electromechanical system technology development
   - 1.2 Introduction to electromechanical system classification and function
2. Electromechanical system 6
   - 2.1 The selection of the electromechanical system
   - 2.2 Selection and design of the core functional components of the electromechanical system
   - 2.3 Processing and purchasing of core functional components of electromechanical system
   - 2.4 Performance testing and integration of the core functional components of the electromechanical system
   - 2.5 Electromechanical system integration and testing
3. Data reorganization and defense 2
   - 3.1 Data collection, and preparation of documents
   - 3.2 Electromechanical system display
   - 3.3 Defence

Laboratories and Laboratory Hours: 54
Students are divided into several teams. Each team selects a complex electromechanical system to design and build. Each team needs to give a presentation weekly. The team members make turns inside. Finally, each team should complete its own electromechanical system and show it in the final defence. The procedure is guided by the teacher.

Grading:

Presentation	20%
Physical display	70%
Performance in class	10%

Text & Reference Book:

[1] Chen Yong [et al.] Electromechanical control technology and application Beijing: People's Posts and Telecommunications Press, 2015

[2] Zhang Jianmin. Mechatronics System Design, Fourth Edition. Beijing: Higher Education Press, 2014

102027106 Mechatronic Control Technology

Lecture Hours: 48
Laboratory Hours: 8
Credits: 3
Term(If necessary): 5
Prerequisite(s): Linear Algebra, College Physics, Matlab software application

Course Description:
The course introduces the design of feedback control systems, properties and the advantages of feedback systems, time-domain and frequency-domain performance measures, stability and degree of stability. It also covers root locus method and frequency-domain design. By learning this course, the students are required to master the basic concepts and principles of the control system analysis and design, to develop the problem-solving skills and feedback control thinking, to lay massive foundation for further study and future career.

Course Outcomes:
After learning this course, the students will be able to obtain a basic understanding of feedback control systems theory, the ability to perform analysis and design of linear feedback control systems, using both time and frequency domain techniques and hands on experience analyzing and designing control system.

Course Content:
Lectures and Lecture Hours: 40
The course includes six chapters which consist of Introduction to Control Systems, Mathematic Models of Control Systems, Time-Domain Analysis of Control Systems, Root Locus Method, Frequency Response Method and Compensation of Control Systems. The break-down details in each chapter make step by step understanding.

Grading:
Final exam 70%
Homework 30%

Text & Reference Book:
1) Richard C.Dorf,Robert H.Bishop .Modern Control Systems [M].Beijing：Higher Education Press，2001.

102027107 Sensing and Testing Technology

Lecture Hours: **40**
Laboratory Hours: **8**
Credits: **3**
Term(If necessary): **6**
Prerequisite(s): Electronic Technology; Engineering Mechanics; College Physics

Course Description:
This course is a foundation course of weapon system engineering, mechanical and electrical engineering. This course is to explore the static and dynamic characteristics, the basic principle, performance and usage of some typical sensors. Combining with the application of weapon system engineering, the students will master the test system analysis and design method for the specific test.

Course Outcomes:
After completing this course, a student should be able to:
1. Descript some engineering signal in time domain and frequency domain and mast the working principle, characteristics ,signal conditioning circuit and application of all kinds of sensors;
2. Use the knowledge about physics, mechanics of materials, electronics to analyze the basic principle of the sensor; use the knowledge about system dynamics, signal and system to analyze the test system or the sensor's static and dynamic characteristics.
3. Solve the testing problems of weapon system and improve the existing weapon testing system and interpret the test data or test results to evaluate the related performance of weapon system.
4. Carry out research on the special problems about sensing and testing in the process of weapon system design.

Course Content:
Lectures and Lecture Hours: 48
Signals and its description; Basic characteristics of the testing device; Measurement error; Commonly used sensor; Signal processing, recording and processing; Displacement measurement; Velocity and acceleration measurement; Force, torque, pressure measurement; Vibration measurement; Temperature and flow measurement.
Laboratories and Laboratory Hours: 8
The class also includes laboratory experience. Laboratory experiments are dynamic characteristic of test system and sensor calibration.

Grading:

Prerequisite quiz	10%
Homework	10%
Final	80%

Text & Reference Book:

3) Wang Huaxiang, Zhang Shuying. The principle and application of sensor (Third Edition) [M]. Tianjin: Tianjin University Press, 2002
4) Zhou Shengguo, Li Shiyi. Test technology for Mechanical Engineering [M]. Beijing: Beijing Institute of Technology Press, 2005

102027108 Microprocessor Systems and Assembly Language

Lecture Hours: 32
Laboratory Hours: 16
Credits: 3
Prerequisite(s): Computer Technology and Programming
Fundmentals of Analog Electronics, Fundmentals of Digital Electronics

Course Description:
The objective of this course is to acquaint students with the principle of microprocessors, including the structure of processors and their operational principle and to familiarize students with the assembly instructions and interface technologies. Students will be able to program the assembly language to solve some practical problems and grasp the method to control the microcomputer. The main topics of course are microprocessor structure and assembly language application. The structure of microprocessor is introduced first and on the basis of this, assembly instructions are studied (this part is emphasized). Then the programming methods are expounded respectively, including simple program, branched program, loop program and subprogram. The last part of this course is the interface technology, mainly deals with the application of parallel and serial interfaces.

Course Outcomes:
1. Knowing and understanding the numeration system, numerical code and other basic knowledge, understand the basic principle of computer, learning the hardware structure and composition of computer, understand the function of the executing components of microprocessor and each bus interface unit and their mutual communication process, understanding external electrical interface and the communication method.
2. Knowing and understanding the assembly language and corresponding programming method, systematically learn the assembly instructions including the special usage and the programming details, complete the assembly language experiments, understand the assembly language programming thought.
3. Master the write, compile, link, operation method of assembly language, able to program using the assembly language on microprocessor, able to design the external circuits and complete the corresponding driver program according to certain application.
4. On the basis of learning the hardware structure of the microprocessor and assembly language, forming the ability to develop the software and hardware of the microprocessor as well as other relating processors.

Course Content:
Lectures and Lecture Hours:

1.	Basic knowledge of Microcomputer - Number and number system - Operation of binary number and its addition circuit	2
2.	The basic circuit of a microcomputer - Tristate output circuit - Bus architecture - Memorizer	1
3.	The operation principle of a microcomputer - Overview and basic components of computer systems - Simplify the operation principle of the computer	4
4.	Microprocessor - Description - Structure of 8086/8088 CPU	6

- Pin signal and operation mode of 8086/8088 CPU
- Main operation function of 8086/8088 CPU

5. Instruction system of a microcomputer 4
   - Assembly language and instruction format of the 86 series
   - CPU addressing mode of the 86 series
   -Instruction system
6. Assembly language and assembler 4
   - Dummy order
   - Macroinstruction
   - System function call
   - Assembler function and process
7. Program design of Microcomputer 5
   - Program design of Microcomputer
   - Simple programming
   - Cycle programming
   - Branch programming
   - Subroutine programming
   - Assembly language programming
8. Input / output interface 6
   - Microcomputer input / output interface
   - Parallel communication and parallel interface
   - Programmable parallel communication interface chip 8255A
   - Serial communication and serial interface
   - Programmable serial communication interface chip 8251A

Grading:

Inclass Quizzes	10%
Experimental Course	20%
Experimental Test	10%
Final	60%

Text & Reference Book:

1) Z. Xuejian, Z. Bing, Principle and Application of Microcomputer, 4th ed., 2013, ISBN 978-7-302-28328-7
2) Kip R. Irvine,Assembly Language for x86 Processors, (6th Edition),2011, ISBN：9787302260301\

102027109 Innovation Practice-Intelligent Robots I

Lecture Hours: 20
Laboratory Hours: 44
Credits: 2
Prerequisite(s): Basis of circuit analysis, Mechanical engineering foundation I and A, Computer control and servo system, Introduction to Robotics

Course Description:
Robotics is an advanced subject which is highly integrated and cross cutting. Through the course of learning, the students will be familiar with the basic robot technology and the development of the situation, and lay a good foundation for the future in intelligent automation technology and equipment system design and manufacturing. Through the course of learning and practice, so that students master the knowledge of robot system, including servo, motion control and system structure design techniques and basic theory.
Robot is a typical machine, electricity, drive, control, measurement, integrated device, it is not a simple combination of mechanical, electronic, but an organic combination of mechanical, electronic, drive, control, etc. Through the practical study of this course, we mobilize the students' initiative, stimulate students' creative thinking, students will learn the literature search, to sum up the analysis and decomposition of key technologies, and try to refine the scientific issues.

Course Outcomes:
After completing this course, a student should be able to:
1. Understand the components of the robot and its functional principles and design methods.
2. Understand the working principle of the robot's mechanism, electric drive, control system ,etc, and the relationship between each other
3. Understand the design methods of mechanism, electric drive and control system, as well as the performance analysis and improvement of robot mechanism, electric drive and control system.
4. Briefly analyse the design of the system according to the requirements of robot system, the selection and design of core technology parameters.
5. Propose the scheme of corresponding robot system selection according to various functional requirements, Analyse the factors affecting the performance of the robot system, develop different robot system design and analysis of the mode of thinking.

Course Content:
Lectures and Lecture Hours:
1. Introduction 4
   - 1.1 Present situation and trend of robot technology development
   - 1.2 Core technologies involved in Robotics
   - 1.3 Robot mechanism, electric drive, and control system
2. Robot mechanism design, process and test method 4
   - 2.1 The position of mechanism in robot technology
   - 2.2 Types and design points of robot mechanism
   - 2.3 Design of robot mechanism
   - 2.4 Machining, assembling and testing of robot mechanism
3. Design technology of robot electric drive 6
   - 3.1 Position of electric drive in robot technology
   - 3.2 Types and design points of robot drive
   - 3.3 Design of robot diver
   - 3.4 Machining, assembling and testing of robot driver
4. Function and design method of robot control system 4

- 4.1 The position of control system in robot technology
- 4.2 Types and design points of robot control system
- 4.3 Design of robot control system
- 4.4 Integration and evaluation of robot control system

5. Data reorganization and defense 2
   - 5.1 Data collection, and preparation of documents and PPT
   - 5.2 Display of robot mechanism, electric drive and control system
   - 5.3 Defence

Laboratories and Laboratory Hours: 44

Students are divided into several teams. Each team selects one kind of robots to design and build. The robot should have moving parts, which are driven by motors. Each team needs to give a presentation weekly. The team members make turns inside. Finally, each team should complete its own electromechanical system and show it in the final defence. The procedure is guided by the teacher.

Grading:

Presentation	15%
Simulation and physical display	50%
Defense	25%
Performance in class	10%

Text & Reference Book:

1) John J Craig;Translated by Chao Yun et al. Introduction to robotics. Third edition, Mechanical Industry Press
2) J.M.Selig;Translated by Xiangdong Yang. The geometric basis of robotics. Tsinghua University press, 2008
3) Zixing Cai.Robotics Second Edition, Tsinghua University press, 2009
4) Aimin Zhang, editor in chief. Automatic control principle. Tsinghua University press 2006
5) Ping Qian, editor in chief. Servo system. Mechanical Industry Press 2005
6) Edited by Jinkun Liu. MATLAB design and Simulation of the robot control system. Tsinghua University press, 2008

102027110 Introduction to Robotics

Lecture Hours: 32
Laboratory Hours: 0
Credits: 2
Prerequisites: Mechanical Design, CAD, Automatic Control Theory

Course Description:
Robot is an archetypical mechatronic system that represents tremendous achievements in modern science and technology. This course is to explore the basic principles and techniques of robotics, which may involve robot structures, computer science, automatic control theory, sensor technology, bionics and artificial intelligence. It is an elective course for juniors and seniors major in mechatronics, and will lead students to profound understanding of mechatronical system.

Course Outcomes:
After completing this course, a student should be able to:
1. Understand mechanisms of serial and parallel robots, manipulators and mobile robots.
2. Master mathematical description methods of rigid body kinematics and transformation of coordinates.
3. Establish kinematical equations of manipulator and solve inverse kinematical equations via D-H parameter description method and joint kinematics.
4. Establish and solve dynamical equations of manipulator using Euler-Newton iterative equation, Lagrangian mechanism and Kane's method.
5.

Course Content:
Lectures and Lecture Hours:

1.	Overview of robot mechanisms - Background - The mechanics and control of mechanical manipulators	2
2.	Foundation of mathematics - Linear transformation - Rotation of rigid body - Transformation of coordinates and homogeneous coordinates	10
3.	Kinematics of simple manipulators - D-H description method and joint kinematics - Kinematics of 6R manipulator - Decoupling of inverse kinematics of manipulators - Velocity, accelerated velocity and statics analysis of manipulators - Performance index of kinetostatics	10
4.	Trajectory planning: pick-and-place operation - General considerations in path description and generation - Joint-space schemes - Cartesian-space schemes - Geometric problems with cartesian paths	6
5.	Dynamics of series manipulators - Inverse dynamics and forward dynamics - Dynamical equations and its dynamical performance of manipulator - Euler-Lagrange equations of serial manipulator	4

Grading:

Homework	30%
Final Exam	70%

References:

1) Zixing Cai. Robotics（2nd version）[M]. Beijing：Tsinghua University Press，2009.
2) Craig, J. J. Introduction to Robotics: Mechanics and Control, 3rd Edition[M], New Jersey: Prentice Hall, 2005.
3) Siciliano, B. and Khatib, O. Springer Handbook of Robotics[M], Berlin: Springer-Verlag, 2008.

102027111 High Frequency Electronics

Lecture Hours: 48
Laboratory Hours: 12
Credits: 3
Prerequisite(s): Fundamental Circuit Analysis, Fundamentals of Analog Electronics

Course Description:
This course is an introduction to high frequency (tens-hundreds MHz range) circuit design and analysis techniques, with particular emphasis on applications for sensing systems. A laboratory experience provides hands-on exposure to typical high-frequency measurement techniques. Students will develop an enhanced understanding of circuit design and analysis principles as applied to high frequency circuits, as well as gain familiarity with design techniques for both hand analysis and computer-aided design.

Course Outcomes:
Designing electronic circuits in the tens and hundreds of MHz range can be a challenge because the presence of parasitics poses a lot of problems in the physical circuits. The objectives of this course is for students to assimilate knowledge of the high frequency characteristics with a focus on sensing systems and will touch upon some basics for the GHz range design.

Course Content:
Lectures and Lecture Hours:

1. General Communication Design 2
2. Resonant Circuits And Filter Characteristics 4
   A. Series
   B. Parallel
   C. Single Tuned
   D. Double Tuned
   E. Crystal And Ceramic And Other Similar Techniques
   F. General If Filter Design Techniques
3. Small Signal High Frequency Amplifiers 6
   A. Models Of Solid State And Tube Devices
   B. Network Parameters
   C. Power Gain
   D. Stability And Alignability
   E. Overall Design Of If And/Or Filter Stages
4. Front End Receiver Design 4
   A. Noise Considerations
   B. Gain And Transducer Stability
   C. Input/Output Parameters
5. Am/Fm General Design 4
   A. Receiving Systems
   B. Receiver Evaluations And Measurements
   C. Front End Design
   D. General Design Of Systems
6. Mixers 4
   A. Basic Mixer Theory And Spectral Analysis
   B. Types Of Mixers
   C. Practical Mixer Design
7. Oscillators And Frequency Synthesizers 4
   A. Oscillator Concepts
   B. Types Of Oscillators

C. Noise In Oscillators
D. Methods Of Frequency Synthesis
E. Phase Lock Loops

8. Detector Design 4
A. Am/Fm Detector Design
B. Basic Circuit Designs
C. Stereo And Multiple Channel Examples

Laboratories and Laboratory Hours:

Oscillator design	3
Small-Signal amplifier design	3
Amplitude modulation/demodulation design	3
Mixer design	3

Grading:

In class Quizzes	30%
Final exam	70%

Text & Reference Book:

Reinold Ludwig et al. RF Circuit Desig Theory and Applications; Second Edition

102027112 Computer Software Practice-Mechatronics

Lecture Hours: 16
Laboratory Hours: 16
Credits: 2
Prerequisite(s): Calculus, Linear Algebra, Fundamentals of Analog Electronics, Fundamentals of Digital Electronics

Course Description:
This course is to train the ability of the students to analyze and solve engineering problem, through learning computer software and practice related to the major of mechatronics. Students should get familiar with Matlab platform and learn to visually demonstrate the whole procedure of how to solve the problem. Through learning Alltium Designer, students should know how to develop the digital products and try to design some kinds of the products related to their research. Finally, Students should know how to logically solve the engineering problem and innovative in their research process.

Course Outcomes:
After completing this course, a student should be able to:
1. Get familiar with the basic calculation in Matlab and also the matrix manipulation, graphical demonstration.
2. Get familiar with the simulation and analysis technique in the Matlab platform.
3. Know the concept about automatic design of PCB and its working principle.
4. Learn how to achieve device packaging, schematic diagram design and wiring in the PCB.

Course Content:
Lectures and Lecture Hours:
1. Basic manipulation in Matlab 2
   - Introduction
   - Basic manipulation
2. Numerical calculation 2
   - Matrix manipulation
   - Basic mathematical function
   - Operation of polynomials of several variables
3. Design of the program in Matlab 2
   - Script and function in M-files
   - Input and output of data
   - Control structure of program
4. Drawing in Matlab 2
   - Ezplot
   - 3D plotting
5. Application of Matlab 2
   - Numerical solution of linear polynomial
   - Data fitting
   - Extreme value
6. Basic manipulation in Altium Designer 2
   - Introduction
   - Basic manipulation
7. Schematic diagram of electric circuit 2
   - Basic concept
   - Setting of user profile
   - Electrical connection
8. Design of printed circuit board 2

- PCB design procedures
- Components layout and adjustment
- Automated wiring and manual wiring

Laboratories and Laboratory Hours:

1. Computer experiment of Matlab 8
   - Basic manipulation and matrix manipulation
   - Programming
   - Drawing
2. Computer experiment of Altium Designer 8
   - Electric connection in the schematic diagram
   - Layout of components and automated wiring in PCB
   - Manual adjustment and wiring

Grading:

Inclass Quizzes	40%
Final exam	60%

Text & Reference Book:

1) Brian D. Hahn， Dan Valentine. Essential MATLAB for Engineers and Scientists；5th edition 1988

102027113 Digital Image Processing

Lecture Hours: 48
Laboratory Hours: 0
Credits: 3
Prerequisite(s): Linear Algebra, Matlab, c programming language

Course Description:
This course is to explore the fundamentals of digital image processing. The basic topics of the representation of digital image, spatial filtering, intensity transform, fourier transform, geometric transformation, color and color transform, and morphological image processing will be introduced. Other topics related to image restoration, image registration, image segmentation and object recognition will NOT be included. The basic operation of Matlab will be presented. Image processing using Matlab image processing toolbox will also be introduced.

Course Outcomes:
After completing this course, a student should be able to:
1. Have a concrete knowledge base on important image concepts including spatial filtering, intensity, color space and transformation, fourier transform of images, geometric transformation, morphological image processing, representation of images.
2. Have a Basic Matlab programming skills.
3. Use Matlab to do image operations including morphological image processing, color space transformation and intensity transformation, geometric transformation, fourier transfom.

Course Content:
Lectures and Lecture Hours:

1. Matlab Introduction		6
1.1 matrices and arrays	2	
1.2 simple calculations and graphs	2	
1.3 programming in Matlab	2	
2. Image Representation		6
2.1 Digital Image Representation	2	
2.2 read, write and plot images	2	
2.3 image types	2	
3. Intensity Transform and Spatial Filtering		6
3.1 Intensity Transformation	2	
3.2 Histogram Processing	2	
3.3 Spatial Filtering	2	
4. Filtering in Frequency Doman		6
4.1 2-D Discrete Fourier Transform	2	
4.2 Filtering in the Frequency Domain	2	
4.3 Frequency Domain filters	2	
5. Geometric Transformation		6
5.1 Transforming Points	2	
5.2 Affine and Projective Transformations	2	
5.3 Image Coordinate Systems and Image Interpolation	2	
6. Color Image Processing		6
6.1 Color Image Representation	2	
6.2 Converting between Color Space	2	
6.3 Color Image Transformations	2	
7. Morphological Image Processing		6
7.1 Dilation and Erosion	2	
7.2 Opening and Closing	2	

7.3 Labeling Connected Components 2

8. Matlab Image processing ToolBox 6

Laboratories and Laboratory Hours: 0 hours

Grading:

Attendance	10%
Excercises	20%
Exam	80%

Text & Reference Book:

1) Gonzalez, Woods and Eddins, Digital Image Processing Using Matlab 2nd Ed, 2009.
2) Gonzalez and Woods, Digital Image Processing, 3rd Ed, 2008.

102027115 Innovation Practice - Intelligent Robots II

Lecture Hours: **10**
Laboratory Hours: **54**
Credits: **2**
Prerequisite(s): a) Robotics b) Computer control and servo system c) Microcomputer principle and interface technology

Course Description:
Robotics is an advanced subject which is highly integrated and cross cutting. Robot technology is a set of mechanics, biology, anthropology, computer science and engineering, control theory and control engineering, electronic engineering, artificial intelligence, intelligent sensing, sociology and other disciplines, which is a strongly comprehensive new technology. Through the practicing and learning of this course, we mobilize the initiative of students, inspire the students' innovative thinking, students will learn to literature query, summary analysis and key technology of decomposition, try to refine scientific problems .We guide the students to construct and developed a robotic system, deepen the understanding of students on robotics and system, cultivate and improve the students' comprehensive use of basic theory and professional knowledge in the innovation ability.

Course Outcomes:
After completing this **course**, a student should be able to:
1. Understand the components of the robot and its functional principles and design methods.
2. Understand the thinking mode affecting the performance of robot system.
3. Understand the Working mechanism and design method, electric drive and control system, as well as the performance analysis and improvement of robot system.
4. Briefly analyse the design of the system according to the requirements of robot system, the selection and design of core technology parameters.
5. Propose the scheme of corresponding robot system selection according to various functional requirements, Analyse the factors affecting the performance of the robot system, develop different robot system design and analysis of the mode of thinking.

Course Content:
Lectures and Lecture Hours:
1. Introduction 2
   - 1.1 Present situation and trend of robot technology development
   - 1.2 Introduction to robot classification and function
2. Robot system 6
   - 2.1 The selection of the robot system
   - 2.2 Selection and design of the core functional components of the robot
   - 2.3 Processing and purchasing of core functional components of robot
   - 2.4 Performance testing and integration of the core functional components of the robot
   - 2.5 Robot system integration and testing
3. Data reorganization and defense 2
   - 3.1 Data collection, and preparation of documents and PPT
   - 3.2 Robot system display
   - 3.3 Defence

Laboratories and Laboratory Hours: 54
Students are divided into several teams. Based on the former experience on designing and making electromechanical systems or robots, each team should work on an innovative intelligent robot. Each team needs to give a presentation weekly. The team members make turns inside. Finally, each team should complete its own electromechanical system and show it in the final defence. The procedure is guided by the teacher.

Grading:

Presentation	15%
Simulation and physical display	50%
Defence	25%
Performance in class	10%

Text & Reference Book:

1 John J Craig. Introduction to robotics. Third Edition, Machinery Industry Press
2 J.M. Selig. The geometric basis of robotics. Tsinghua University Press 2008

102027116 Measurement and Virtual Instruments

Lecture Hours: 32
Laboratory Hours: 16
Credits: 3
Prerequisite(s):

Course Description:
The main goal of this course is for students to learn applications of programming, signal transduction, data acquisition, data analysis, signal processing used in the design of mechanical and electronical instrumentation. The software package LabVIEW has become a standard in academic and industrial environments for data acquisition, interfacing of instruments and instrumentation control. Students in this course will learn LabVIEW as a tool for the design of computer-based virtual instruments, which add software-based intelligence to sensors and basic laboratory bench devices.

Course Outcomes:
- Develop LabVIEW programs called virtual instruments featuring numeric and string manipulation, program structures, data structures, file input-output, outside-world interfacing, data analysis and signal processing;
- Design software applications and graphical user interfaces in LabVIEW using good programming techniques, including documentation, and an understanding of human computer interfaces;
- Analyze a data acquisition system including transducers, signal conditioning elements, and plug-in DAQ computer boards;
- Design a data acquisition system with understanding of the trade-offs for different signal types, number of channels, sampling resolution, and sampling frequency ;
- Experiment, analyze, and document in the laboratory prototype measurement systems using plug-in DAQ, a computer, and bench instruments;
- Integrate knowledge for data analysis and signal processing learned in previous courses in systems for measurement and analysis of signals;
- Function effectively as part of a group of student engineers working on a multi-week project;
- Document in writing and orally exercises and projects performed individually and as part of a team of student engineers;
- Independently acquire through reading, practice exercises, and self-initiated research technical knowledge related to the course content and projects.

Course Content:
The course plan detailed below reflects the course goal and the learning objectives. "Lecture + activities" sessions emphasize the development of LabVIEW programming skills and virtual instrument design skills through knowledge acquisition and practice. Different types of sensors are described and analyzed. Techniques for data analysis and processing of physiologic signals are reviewed and integrated in LabVIEW applications. Homework problems, laboratories, and a final project sharpen the acquired knowledge and skills and extend them to the development of realistic instrumentation systems. The class material is covered in the following tentative order
- Introduction to LabVIEW
- Loops – Graphs – Arrays in LabVIEW
- Case and other structures – Strings – Clusters
- Front panel editing – Boolean operations – Files – Waveforms
- Properties of signals – Data acquisition
- Instrument control basics – Pulse oximetry (student lesson)

- Instrument control with LabVIEW
- Software design principles – Property nodes – Midterm 1
- Component oriented design – Light measurements
- Basic software architectures
- Graphic user interface principles – Creating a medical device company (student lesson)
- Graphic user interface design with LabVIEW – TBD (student lesson)
- Digital signal processing
- Conclusions

Laboratories and Laboratory Hours:

Grading:

In class Quizzes	40%
Final exam	60%

Text & Reference Book: