Department of Biomedical Engineering
College of Engineering
King Faisal University
Al Ahsa, Kingdom of Saudi Arabia

Welcome to the Biomedical Engineering (BME) department at King Faisal University (KFU). During the last two decades, biomedical engineering has been rapidly growing with the increasing demand to biomedical engineers. This branch of engineering is an interdisciplinary field that applies the concepts of engineering and technology to solve medical and biological problems and to improve the performance of healthcare communities. The biomedical industry and healthcare organization are continuously seeking highly qualified biomedical engineers. Upon that significant demand to biomedical engineers, KFU launched the BME department in 1435 H (2014 AD) to offer a bachelor's degree in BME for female students. The number of students admitted to BME program is multiplied year after the other which enforces the college of engineering board to continuously improve the department and keep in line with higher education quality standards. The department is currently well-equipped with recent labs and other teaching facilities. Also, highly qualified faculty members are happy to teach excellent students in our department and guide them to get started in their careers after graduation. As a part of KFU, BME department is very keen to contribute verifying the KFU vision. Our department aims to be one of the leading BME departments locally and internationally through distinct KFU-graduated BM engineers and planned researchers. The BME department at KFU is currently adding research facilities and planning to offer a master's degree in biomedical engineering next years.   **Prof. Nahed Solouma, Chair of Biomedical Engineering.**

Biomedical Engineering Mission:

The Department of Biomedical Engineering is committed to improving healthcare technology outcomes and offering quality community services by:
- Providing quality education of biomedical engineering through project-based and problem-solving teaching and learning.
- Producing research that leads to better solutions to biomedical engineering-related problems with emphasis on issues of national significance by working closely with industry and research centers.

Program Educational Objectives (PEOs):

The BME graduates are expected to attain the following program educational objectives within a few years of graduation:

PEO 1: Become technically competent biomedical engineers.

PEO 2: Demonstrate effective leadership skills in a diverse environment.

PEO 3: Engage in life-long learning for the purpose of professional development.

PEO 4: Pursue graduate studies and research in biomedical engineering.

Student Outcomes (SOs):

The graduates of the Biomedical Engineering Department, College of Engineering at King Faisal University are expected to demonstrate:

1) Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2) Ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3) Ability to communicate effectively with a range of audiences.
4) Ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5) Ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6) Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7) Ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Study Plan of the Undergraduate Program (BSc Degree)

① First Semester					
Course Code	**Course Title**	**CH**	**Required/Elective**	**Pre-& Co-requisite**	**Category Curriculum**
ENG 133	English Composition I	2	Required	None	General Education
Math 144	Calculus I	4	Required	None	Math
Phys 140	General Physics I	3	Required	C: Math 144 & Phys 144	Basic Science
Phys 144	General Physics I Lab	1	Required	C: Phys 140	Basic Science
Engr 100	Introduction to Engineering	1	Required	None	Engineering Topics
Semester Credit Hours		**11**			

② Second Semester					
Course Code	**Course Title**	**CH**	**Required/Elective**	**Pre-& Co-requisite**	**Category Curriculum**
ENG 134	English Composition II	2	Required	P: Eng 133	General Education
Math 145	Calculus II	4	Required	Math 144	Math
Chem 140	General Chemistry I	3	Required	None	Basic Science
Engr 106	Engineering Graphics	2	Required	None	Engineering Topics
Semester Credit Hours		**11**			

③ Third Semester					
Course Code	**Course Title**	**CH**	**Required/Elective**	**Pre-& Co-requisite**	**Category Curriculum**
Eng 138	Fundamentals of Speech Communication	2	Required	C: Eng 134	General Education
Chem 142	General Chemistry II	3	Required	P: Chem 140 & C: Chem 143	Basic Science
Chem 143	General Chemistry Lab	1	Required	C: Chem 142	Basic Science
Phys 141	General Physics II	3	Required	P: Phys 140 & C: Phys 145	Basic Science
Phys 145	General Physics II Lab	1	Required	C: Phys 141	Basic Science
Engr 105	Engineering Computing & Skills	2	Required	C: Math 145	Engineering Topics
Semester Credit Hours		**12**			

④ Fourth Semester					
Course Code	**Course Title**	**CH**	**Required/Elective**	**Pre-& Co-requisite**	**Category Curriculum**

Math 240	Differential Equations	3	Required	P: Math 145	Math
Engr 206	Electric Circuits	3	Required	P: Phys 141	Engineering Topics
EE 247	Electric Circuits Lab	1	Required	C: Engr 206	Engineering Topics
BME 316	Logic Design and Microprocessors for BME	3	Required	P: Engr 106	Engineering Topics
Semester Credit Hours			**10**		

⑤ Fifth Semester

Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
Eng 137	Technical Writing	2	Required	P: Eng 134	General Education
Math 244	Multivariate Calculus	3	Required	P: Math 145	Math
Engr 223	Engineering Mechanics	3	Required	P: Math 145 & Phys 140	Engineering Topics
BME 310	Biomedical Electronics l	3	Required	P: Engr 206	Engineering Topics
BME 313	Biomedical Electronics Lab	1	Required	C: BME 310	Engineering Topics
Semester Credit Hours			**12**		

⑥ Sixth Semester

Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
Engr 303	Thermofluids	3	Required	P: Phys 141, Chem 142 & Math 244	Engineering Topics
BME 202	Molecular Biology and Genetics	3	Required	P: Chem 142	Engineering Topics
BME 204	Anatomy and Physiology l	3	Required	P: Chem 142	Engineering Topics
BME 312	Biomedical Electronics ll	3	Required	P: BME 310	Engineering Topics
Semester Credit Hours			**12**		

⑦ Seventh Semester

Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
SSC 101	Creed and doctrines	2	Required	None	General Education
Engr 310	Numerical Methods	3	Required	P: Math 240	Math
BME 220	Biomaterials	3	Required	P: Phys 141, BME 202 & BME 204	Engineering Topics
BME 304	Anatomy and Physiology ll	3	Required	P: BME 204	Engineering Topics
Semester Credit Hours			**11**		

⑧ Eighth Semester					
Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
SSC 102	Islamic culture	2	Required	None	General Education
Engr 340	Probability & Statistics for Engineers	3	Required	P: Math 145	Math
CS 204	Engineering Programming	3	Required	P: Math 144	Engineering Topics
BME 322	Biomedical Transport Phenomena	3	Required	P: Engr 303 & BME 304	Engineering Topics
Semester Credit Hours		11			

⑨ Ninth Semester					
Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
SSC xxx	University Elective	2	Elective	None	General Education
BME 314	Biomedical Signals and Systems	3	Required	P: Engr 206 & BME 304	Engineering Topics
BME 320	Biomechanics	3	Required	P: Engr 223, BME 204 & BME 220	Engineering Topics
BME 410	Biomedical Instrumentation l	3	Required	P: BME 304, BME 312 & C: BME 411	Engineering Topics
BME 411	Biomedical Instrumentation l Lab	1	Required	C: BME 410	Engineering Topics
Semester Credit Hours		12			

Summer Semester					
Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
Engr 399	Engineering Training	0	Required	P: Eng 137 & BME 410	
Semester Credit Hours		0			

⑩ Tenth Semester					
Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
SSC xxx	University Elective	2	Elective	None	General Education
BME 412	Biomedical Instrumentation ll	3	Required	P: BME 410 & C: BME 413	Engineering Topics
BME 413	Biomedical Instrumentation ll Lab	1	Required	C: BME 412	Engineering Topics
BME 430	Biomedical Image Processing	2	Required	P: BME 314	Engineering Topics

Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
BME 4xx	Technical Elective	3	Elective		Engineering Topics
Semester Credit Hours			**11**		

⑪ Eleventh Semester

Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
Engr 307	Engineering Economics	3	Required	P: Engr 100	Engineering Topics
BME 330	Biomedical Imaging Systems	3	Required	P: BME 312 & BME 314	Engineering Topics
BME 331	Biomedical Imaging Systems Lab	1	Required	C: BME 330	Engineering Topics
BME 450	Senior Design I	2	Required	P: BME 410	Engineering Topics
BME 4xx	Technical Elective	3	Elective		Engineering Topics
Semester Credit Hours			**12**		

⑫ Twelfth Semester

Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
Mgt 292	Management Fundamentals & Skills	3	Required	None	General Education
BME 440	Management of Healthcare Technology	3	Required	P: BME 412	Engineering Topics
BME 452	Senior Design II	2	Required	P: BME 450	Engineering Topics
BME 4xx	Technical Elective	3	Elective		Engineering Topics
Semester Credit Hours			**11**		
Total Credit Hours of the Program			**136**		

Department Technical Electives					
Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Curriculum Category
BME 414	Biomedical Digital Signal Processing	3	Elective	P: Engr 105 & BME 314	Engineering Topics
BME 416	Introduction to BioMEMS, and Bionanotechnology	3	Elective	P: BME 202 & BME 220	Engineering Topics
BME 420	Prosthetic Systems for Biomedical Engineers	3	Elective	P: Engr 105, BME 304 & BME 320	Engineering Topics
BME 432	Biomedical Data Processing, Archiving, and Communication	3	Elective	P: BME 430	Engineering Topics
BME 442	Information Technology for Biomedical Engineers	3	Elective	P: Engr 105	Engineering Topics
BME 444	Medical Device Innovation and Entrepreneurship	3	Elective	P: BME 410	Engineering Topics

Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
BME 460	Selected Topics in Biomedical Engineering	3	Elective	P: BME 410	Engineering Topics
BME 462	Undergraduate Research in Biomedical Engineering	3	Elective	P: BME 322	Engineering Topics

University Electives (Before Fall 2018/2019)					
Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
Deic 102	Fiqh Biography	2	Elective	None	General Education
Deic 302	Islam and Science and Technology Issues	2	Elective	None	General Education
Deic 317	Islamic Morals and Ethics	2	Elective	None	General Education
Deic 318	Economic System in Islam	2	Elective	None	General Education
Deic 401	Islamic Social System	2	Elective	None	General Education
Deic 418	Political System and Human Rights in Islam	2	Elective	None	General Education

University Courses (For Batch 2018 & above): From Supporting Studies Center					
Course Code	Course Title	CH	Required/Elective	Pre-& Co-requisite	Category Curriculum
SSC101	Creed and doctrines	2	Required	None	General Education
SSC102	Islamic culture	2	Required	None	General Education
SSC103	Islamic Morals and Ethics	2	Elective	None	General Education
SSC104	Studies in the Biography of the Prophet	2	Elective	None	General Education
SSC105	Medical jurisprudence	2	Elective	None	General Education
SSC106	Economics & Politics in Islam	2	Elective	None	General Education
SSC107	Islamic Social & Family Behaviour	2	Elective	None	General Education
SSC108	Management & Entrepreneurship	2	Elective	None	General Education
SSC109	Health & Fitness	2	Elective	None	General Education
SSC110	Research skills	2	Elective	None	General Education
SSC111	Volunteer work	2	Elective	None	General Education
SSC112	Medicine: Type and use	2	Elective	None	General Education
SSC113	Human Rights in Islam	2	Elective	None	General Education
SSC114	Food and Nutrition	2	Elective	None	General Education

Course Descriptions (Catalogue)

General Education

Eng 133–English Composition I 2(3-0-0): This is an intermediate level writing class. Students are guided through the stages of the writing process to write paragraphs that are both meaningful and organized and include a topic sentence with a controlling idea and conclusion. Students write multi-draft compositions from a variety of practical and academic purposes. They improve their writing by studying model sentences and paragraphs, basic sentence patterns, mechanics, coordinating conjunctions, transitions and vocabulary. Pre-requisite: None.

Eng 134–English Composition II 2(3,0,0): This English course is designed to take learners from the paragraph level of writing in English to the Essay level. It concentrates of the essential form and function of the essay and prepares the ground for the academic essay. Particular importance is given to tasks of description and argumentation, including work on comparison, definition, cause-effect and expression of opinion in essay writing. Thus, students are taken through the major stages of the essay composition process. Pre-requisite: Eng 133.

Eng 137–Technical Writing 2(3-0-0): This course introduces students to the fundamentals of writing, designing and conveying technical information to different audiences. Students will learn about technical writing conventions, such as organization, style and tone and illustration and layout as they work through the writing process to produce a variety of common technical documents that they will encounter in their academic work. Pre-requisite: Eng 134.

Eng 138–Fundamentals of Speech Communication 2(3-0-0): A study of communication theories as applied to speech: practical communicative experiences ranging from interpersonal communication and small-group process through problem identification and solution in discussion, to informative and persuasive speaking in standard speaker-audience situations. Co-requisite: Eng 134.

Mgt 292–Management Fundamentals & Skill 3(4.5-0-0): The course covers Management fundamentals & Skill, such as, Global Management - Change and Innovation - Appendix: Managing Entrepreneurial Ventures - Decision Making - Strategic Management - Module Planning Tools and Techniques - In class discussion: Ethics Dilemma - Operations Management - Marketing Management - E Business - Marketing Plan - Human Resource Management - Team Building - Foundations of Individual Behaviour - Communication. Pre-requisite(s): None.

SSC 101-Islamic Creed and Contemporary Doctrines 2(3-0-0): Creed: definition, importance, sources, characteristics, study methodology, pillars of faith, influence of creed on individuals and society, belief nullifiers, thought constraints, study of some contemporary doctrines: secularism, Satan worshipers, Baha'ism, Zionism, Misoneism, Christian fundamentalism. Student is required to memorize part of the holy Quran. Pre-requisite(s): None.

Deic 317-Islamic Morals and Ethics 2(3-0-0): Morals (Ethics: definition and foundations, characteristics, study of model samples of the Prophets' morals and ethics, tools of moral/ethical education in Islam. Concept of profession and its importance in human life, constituents of professional morals/ethics and its constraints, model samples of professional morals/ethics in Islam. Student is required to memorize part of the holy Quran. Pre-requisite(s): None.

Deic 318-Economic System in Islam 2(3-0-0): Islamic Economy: (its nature and principles, development, and characteristics), the economic problem and how to face it, contemporary economic systems (capitalism, socialism), economic globalism, World Bank and its goals, World Trade Organization and its goals, ownership in Islam: definition, types, constraints. Islam and economic freedom, Production, distribution, expenditure, economic policies in contracts and transactions. Student is required to memorize part of the holy Quran. Pre-requisite(s): None.

Deic 401- Islamic Social System 2(3-0-0): Society: definition, building blocks of society in Islam, Islamic society attributes, Family in Islam: definition, status, importance, building blocks, marriage and its purposes, spouses' rights, parents, siblings, and relatives' rights, women's status and rights in Islam, Family controversial issues about family system in Islam and responding to those issues (polygamy, inheritance, veil, divorce, etc.), Family problems and remedies (women's work, alimony, stewardship, etc.). Student is required to memorize part of the holy Quran Pre-requisite(s): None.

SSC 102-Contemporary Cultural Issues 2(3-0-0): Moderation, Islam globalism and human ties, discrimination and nationalism, Arabic as the medium of education and culture, science and religion, interfaith dialogue, Orientalism and Christianization, Colonialism, Westernization, modernity in literature, Globalization, Terrorism, Development of Moslem nations Pre-requisite(s): None.

Math and Basic Sciences

Math 144–Calculus I 4(6-0-0): This is an introductory course of mathematics for college of engineering students. The course covers the basic concepts and methods of calculus. At the beginning of the course the instructor will provide students the knowledge of the number systems, algebraic operations and functions of single variable with domain and range so that students

can learn differentiation of the functions. The main topics to be covered in this course include: Limits, Continuity, Differentiation of functions of a single variable, Exponential, Logarithmic, Trigonometric, Inverse trigonometric functions, Applications of derivatives, Differentials, Curve Sketching, L'Hospital Rule, Mean value theorems, Area and estimating with finite sums, Introduction to integrals and definite integrals. Pre-requisite: None.

Math 145–Calculus II 4(6-0-0): This is an intermediate level calculus course designed for undergraduate Engineering students. This course covers mainly the integration and basic principles of Vectors and their applications. At the beginning of this course, the instructor will give the review of differentiation and integration. In depth, the students will learn the methods of integration and vectors. The topic covered include, Techniques of Integration, Improper Integration, Applications of Integration, Infinite Sequences and Series, (Power series and Taylor series), Polar coordinates, Transcendental Functions, Vectors, Vector Valued Functions. Pre-requisite: Math 144.

Math 240–Differential Equations 3(4.5-0-0): This course is an introductory course of differential equations for college of engineering students. The course covers different methods and concepts to solve first and second order differential equations. At the beginning of the course we discuss some definitions and terminology about differential equations. Then we move to solving first and second order differential equations. The topics in this course include, linear differential equations, solving first order differential equations, solving second order differential equations, series solutions of second order linear differential equations, solving systems of linear differential equations, Laplace transform and its applications in solving differential equations. Pre-requisite: Math 145.

Math 244–Multivariate Calculus 3(4.5-0-0): This course is an advanced course in calculus, designed for undergraduate students of engineering. The course covers the basic principles and methods of differentiation and integration of two or more variables. At the beginning of the course, the Instructor will give a review of functions of one variable and its differentiation and integration. Then, the functions of two or more variables with domain and range will be discussed. Throughout the course, the following main topics will be covered: solid analytic geometry; vector calculus; partial derivative; and multiple integrals. The coverage will also include relevant and important applications in the sciences and engineering. Pre-requisite: Math 145.

Phys 140–General Physics I 3(4.5-0-0): The course is an introduction to units, measurements, motion in one and two dimensions, kinematics and dynamics, Newton's laws, work and energy, rotational dynamics, linear and angular momentum, torque, and collisions.

Basic calculus and multi-variable algebra will be used. Co-requisite: Math 144 & Phys 144.

Phys 144–General Physics I Lab. 1(0-0-3): Measure basic constants such as length, weight and time, value of acceleration due to gravity. Design and conduct experiments in mechanics. Analyze and interpret experiment data. Write a scientific report. Draw and interpret a graph. Apply experimental principles and error calculations to mechanics. Co-requisite: Phys 140

Phys 141–General Physics II 3(4.5-0-0): This course introduces students to the physics of electricity and magnetism and the connections between them. The concepts of electric charge, electric field, electric potential, Kirchhoff Law, Gauss Law, electric and magnetic fluxes, capacitance, resistivity and resistance, connections in series and in parallel, RC-circuit, magnetic field, magnetic force, magnetic and electric torques, Ampere Law, electromagnetic induction, and Faraday Law and Lenz Law will be taught. Pre-requisite: Phys 140. Co-requisite: Phys 145.

Phys 145–General Physics II Lab. 1(0-0-3): This course introduces students to the basic electrical measurements' techniques and to the physics of electricity and magnetism. The concepts of basic measurements, Resistors in series and in parallel, Verifying Ohm's law, Wheatstone Bridge, Verifying Kirchhoff's Laws, Resistivity, Capacitors in series and in parallel, RC circuit, Introduction to Oscilloscope, the Mechanical Equivalent of Heat, the Negative Temperature Coefficient of Resistance (Thermistor), Galvanometer, and the Magnetic Moment will be taught. Co-requisite: Phys 141.

Chem 140-General Chemistry I 3(4.5-0-0): Matter properties and measurement, Atoms and the Atomic Theory, Chemical Compounds, Chemical Reactions, Reactions in Aqueous Solutions, Liquids Solids and Intermolecular Forces, Electrons in Atoms, Periodic Table and Atomic Properties, Chemical Bonding, Valence-Bond, Hybridization of Atomic Orbital, Multiple Covalent Bonds, Molecular Orbital Theory, Liquids and Solids. Pre-requisite: None.

Chem 142-General Chemistry II 3(4.5-0-0): Properties of Gases: Kinetic-molecular theory of gases, Ideal gas law, Mixtures of gases, Thermo- chemistry, Principles of Chemical Equilibrium, Acids and Bases, Buffer Solutions, Neutralization Reactions and Titration Curves, Solubility and Complex-Ion Equilibria, Spontaneous Change: Entropy and Free Energy, Thermodynamic, Solutions and Their Physical Properties, Chemical Kinetics and Electrochemistry. Pre-requisite: Chem 140. Co-requisite: Chem 143.

Chem 143–General Chemistry Lab. 1(0-0-3): Laboratory safety rules and Evaluation of analytical data, Definition and determination of density, explanation and determination of specific heat, concept of Acids, bases and Heat of Neutralization Reaction and

its determination, reversible reactions, concept of equilibrium constant and its determination, LeChatelier principle and its verification, principle involved in Acid base titrations, indicators, Ionization of electrolytes, determination of dissociation constant of weak acid(Ka), principle involved in complex metric titrations, hardness of water and its determination. Co-requisite: Chem 142.

Common Engineering Courses

Engr 100-Introduction to Engineering 1(1.5-0-0): This course introduces engineering to students, particularly those who are interested in an engineering profession. It covers engineering ethics, teamwork, communication skills, engineering topics, and engineering problem solving skills and design methodology. Pre-requisite: None.

Engr 105-Engineering Computing & Skills 2(3-0-0): Problem solving skills and computing using MATLAB. Pre-requisite: Math 145.

Engr 106–Engineering Graphics 2(3-0-0): An introductory course in engineering graphics focuses on graphical communication. Topics include descriptive geometry elements, visualization, engineering drawing techniques, orthographic projection, pictorial representation, section views, and basic dimensioning. The course incorporates computer aided drafting (CAD) with engineering applications using 2-D drawing. This course is divided in to two sections: sketching and AutoCAD. The course begins by teaching the basics of engineering graphics using sketching. Freehand sketching using only a pencil and paper is an important skill for any engineer. It is a means of quickly conveying technical information to others. Through sketching the concepts of pictorial projections, section views, auxiliary views and dimensioning are taught. Once the foundation of engineering graphics is known, these concepts can be applied using computer aided design (CAD) software. AutoCAD is taught first. AutoCAD is a drawing software package used to create two-dimensional engineering drawings. Pre-requisite: None.

Engr 206-Electric Circuits 3(4.5-0-0): Resistors, capacitors, inductors, currents; voltages; power and energy; circuit analysis techniques; DC and AC analysis; magnetic circuits and transformers; Introduction to DC and AC machines. Pre-requisite: Phys 141.

EE 247 Electric Circuit Lab 1(0-0-3): Lab experiments using resistors, inductors, capacitors, function generators, DC supplies Multimeters, and Oscilloscopes. Focus will be on DC inputs. Software circuit simulations will be used. Co-requisite: Engr 206.

Engr 223-Engineering Mechanics 3(4.5-0-0): Engineering Mechanics, covering both statics and dynamics. Topics include vector algebra, force systems, free-body diagrams, equilibrium of particles and rigid bodies, kinematics of particles and rigid bodies, Newton's laws applied to particles and rigid bodies, friction. Pre-requisite(s): Math 145 & Phys 140.

Engr 303–Thermofluids 3(4.5-0-0): Basic concepts of thermodynamics, properties of pure substances, energy transfer by heat, work, and mass, first and second laws of thermodynamics, basic principles and concepts of fluid mechanics including fluid statics, momentum analysis of flow structures, Bernoulli and energy equations, flow in pipes, basic principles of heat transfer including modes of heat transfer, steady heat transfer. Pre-requisite(s): Phys 141, Chem 142 & Math 244.

Engr 307–Engineering Economics 3(4.5-0-0): The course covers the following topics: Engineering Economic Decisions; Understanding Financial Statements; Cost Concepts and Behaviors; Time is Money; Understanding Money and Its Management; Principles of Investing; Present Worth Analysis; Annual Equivalent Worth Analysis; Rate of Return Analysis; Depreciation; Taxes; Break-Even Analysis, Cost Estimation; Developing Project Cash Flows; Inflation; Replacement Decisions. Pre-requisite(s): Engr 100.

Engr 310-Numerical Methods 3(4.5-0-0): Introduction to Numerical Methods, Solution of Nonlinear Equations, Solution of Simultaneous Linear Algebraic Equations, Solution of Matrix Eigenvalue Problem, Curve Fitting and Interpolation, Numerical Differentiation, Numerical Integration, Ordinary Differential Equations: Initial-Value Problems, Ordinary Differential Equations: Boundary-Value Problems. Prerequisite: Math 240.

Engr 340-Probability and Statistics for Engineers 3(4.5-0-0): This course provides a comprehensive introduction to those models and methods most likely to be encountered and used by students in their careers in engineering and the natural sciences. Some homework requires use of computers. The course will cover: Introduction to Statistics and Data Analysis, Probability, Random Variables and Probability Distributions, Mathematical Expectations, Some Discrete Probability Distributions, Functions of Random Variables, Fundamental Distributions and Data Description, Simple Linear Regression, Multiple Linear Regression, and Bayesian Statistics. The students can use Microsoft Excel or any other statistical software in their projects. Prerequisite: Math 145.

CS 204–Engineering Programming 3(4.5-0-0): Introduction to computer systems; problem solving methodology; testing and debugging of programs; variables, declarations, and assignments; input and output; data types; control flow and looping; functions and overloading; streams and input/output; one-dimensional arrays; two-dimensional arrays; pointers and dynamic arrays; structures; abstract data types and classes; inheritance; friends, overloaded operators, and arrays in classes; recursive functions.. Projects that will

require lab work will be assigned weekly. Prerequisite: Math 144.

Engr 399-Engineering Training 0(0-0-0): All engineering students are required to undergo a comprehensive "Engineering Training Program" with a reputable and specialized industrial firm. The firm can be in or outside Saudi Arabia relevant to his major area of interest in engineering analysis, design, or construction. The main purpose of this summer training is to enhance the students' practical experience and career abilities. Also, it deepens their engineering knowledge acquired during their academic years in the field of practical experience in real-life engineering projects. Additionally, such a program improves the relationship between the College of Engineering and the governmental and private industrial firms. Also, it can provide the industry with well-trained professionals in the near future. The qualifying student should spend at least eight weeks in a governmental organization, a reputable industrial firm, or a research center that is involved with engineering activities. Two months of full-time training. Pre-requisite: Eng 137 & BME 410.

BME Courses

BME 202-Molecular Biology and Genetics 3(4.5-0-0): This is an introductory course in molecular biology and genetics. Students will learn the nomenclature and current knowledge about the cell and its structures. Topics include chemical bonds; macromolecules; protein structure and function; enzymes; cell structure and function; cellular respiration; cell signaling; cellular reproduction and life cycle; cellular communication; structure and nature of DNA and genetics. Prerequisite: Chem 142.

BME 204-Anatomy and Physiology I 3(4.5-0-0): The objective of this course is to present the concepts of human anatomy and physiology that are most pertinent to the field of biomedical engineering. Concepts from the following topics will be covered: homeostasis; cell membrane potentials and transport mechanisms; nerves; muscular, cardiovascular and circulatory systems. Modeling of living systems will be covered as well. Prerequisite: Chem 142.

BME 220-Biomaterials 3(4.5-0-0): This course introduces the science of materials with emphasis on materials used in biomedical applications such as surgical implants, medical devices, dental restoration, drug delivery systems, etc. Students shall learn the classes of biomaterials and their properties, characteristics, biological response, and clinical applications. Other topics include biocompatibility, biodegradation, and performance and design requirements of materials for medical applications. Prerequisite: Phys 141, BME 202 & BME 204.

BME 304-Anatomy and Physiology II 3(4.5-0-0): The objective of this course is to present the concepts of human anatomy and physiology that are most pertinent to the field of biomedical engineering. It is a continuation of Anatomy and Physiology I course. Concepts from the following topics will be covered: autonomic nervous system; blood; lymphatic and immunity; respiratory, urinary, endocrine and digestive systems. Prerequisite: BME 204.

BME 310-Biomedical Electronics I 3(4.5-0-0): Diodes characteristics, models and applications (rectification, clipping, regulation, etc); Bipolar Junction Transistors (BJT) and Field Effect Transistors (FET): states and modes of operation of these devices; BJT and FET amplifiers; multistage amplifiers; frequency response of amplifiers. Prerequisite: ENGR 206.

BME 312-Biomedical Electronics II 3(4.5-0-0): Operational amplifiers, power amplifiers, differential & multistage amplifiers and their medical applications; passive and active filters; comparators; oscillator circuits and applications; functional integrated circuits (V/f converters, A/D converters… etc); frequency response; control systems; analysis and design of feedback control systems and applying these principles to solve biological feedback control problems. Prerequisite: BME 310.

BME 313-Biomedical Electronics Lab 1(0-0-3): The goal of this laboratory is to study electronics through experimentation. Upon completion of this lab course, students should be able to use standard laboratory equipments to analyze the behavior of basic electronic devices and to design and construct simple circuits containing these devices. Co-requisite(s): BME 310.

BME 314-Biomedical Signals and Systems 3(4.5-0-0): Biosignals and their Non-deterministic properties. Models for Biomedical systems. System response and Stability, Fundamentals of continuous-time signal processing as applied to biomedical instrumentation. Random noise and signal processes. Time Domain and Frequency Domain Analysis of Signals and System, Sampling theory, Applications of Fourier transforms and Laplace transforms, Transfer functions. Analog filter design methods for biomedical instrumentations. Discrete-time signal processing and Digital filter design will be introduced in this course. Projects and software will be used. Pre-requisite(s): Engr 206 & BME 304.

BME 316-Logic Design and Microprocessors for BME 3(4.5-0-0): This is an introductory course in digital logic design and microprocessor systems. The course shall include introduction to digital systems; Boolean algebra; Combinational circuit analysis; Sequential circuit analysis and design that includes counters, registers and timers… etc. The fundamental principles of digital logic design shall be applied to understand Microprocessor organization and architecture; assembly language programming; CPU; Memory, I/O, and parallel processing. Biomedical Engineering applications shall be discussed wherever applicable. Pre-requisite(s): Engr 106.

BME 320-Biomechanics 3(4.5-0-0): This course applies the principles of solid mechanics to musculoskeletal system. Topics include kinematics,

kinetics, and biomechanics of locomotion. Students will learn the microstructure and mechanical properties of biological tissues such as bones, joints, blood vessels, muscle, heart…etc. The learned concepts of biomechanics will be applied to those body tissues. Design and analysis projects will be assigned. Pre-requisite(s): Engr 223, BME 204, & BME 220.

BME 322-Biomedical Transport Phenomena 3(4.5-0-0): Topics include reaction-diffusion processes; transport across membranes; fluid flow in the circulatory system and other tissues; oxygen transport in lungs and tissues; pharmacokinetics; biomedical engineering applications and devices: extracorporeal devices (e.g. hemodialysis, blood oxygenators, etc) and artificial organs. Pre-requisite(s): Engr 303 & BME 304.

BME 330-Biomedical Imaging Systems 3(4.5-0-0): This course covers the fundamentals of different types of medical imaging modalities. Topics include the physics, mathematics, instrumentation and clinical applications of different imaging modalities including X-rays, Computed Tomography (CT), Fluoroscopy, Ultrasound Imaging, Optical Imaging, Nuclear Imaging (SPECT, PET) and Magnetic Resonance Imaging (MRI). Pre-requisite(s): BME 312 & BME 314.

BME 331-Biomedical Imaging Systems Lab 1(0-0-3): This laboratory focuses on the main medical imaging modalities in BME 330 and provides a hands-on experience for students to practically apply the knowledge they have learned in BME 330. Medical images will be acquired using different modalities, analyzed, reconstructed, and archived. Co-requisite(s): BME 330.

BME 410-Biomedical Instrumentation I 3(4.5-0-0): This is the first course in bioinstrumentation covering clinical measurements. Topics include the origin of Biopotentials: cell, nerve, and muscle potentials; Biopotential electrodes; Biosensors and Transducers; Basic Theories of Measurements and concepts of Medical Instrumentation; Modular Block and System Integration; electrocardiogram (ECG); electroneurogram; electromyogram (EMG); electroretinogram; electroencephalogram (EEG); Cardiovascular system and associated measurements; Blood pressure and Blood flow Measurements; Measurements of the respiratory System; Pulmonary Function Analyzers; Audiometry; Introduction to Biomedical Virtual instrumentation. The Course shall explore the design, operation, safety aspects and calibration of the respective instrumentations. Pre-requisite(s): BME 304, BME 312. Co-requisite(s): BME 411.

BME 411 Biomedical Instrumentation I Lab 1(0-0-3): This laboratory-based course is designed to develop hands-on experimental skills to the selection and application of various sensors and transducers, and develop practical experience to designing, using and testing analog instrumentation used to acquire and process biomedical signals. Students shall develop skills in writing Matlab programs and employing LabView to perform signal processing on biomedical signals such as ECG and testing electrical equipment against safety standards. It will inculcate the safety issues involved in bioelectrical measurement and medical instrumentation.

Teamwork and written communication skills are emphasized through laboratory report organization, documentation of results, error analysis and interpretation of findings. Co-requisite(s): BME 410.

BME 412-Biomedical instrumentation II 3(4.5-0-0): Students shall explore the design, operation, safety aspects and calibration of the respective instrumentation: Patient Monitoring Systems, Bedside Monitors and Central Monitors, Arrhythmia and Ambulatory Monitoring, Biomedical Wireless Telemetry, Introduction to networking concepts in Medical Devices. Clinical Laboratory Instrumentation (types and principle of operation): Electrophoresis, ELISA, Hematology, Chromatography, Spectroscopy and Spectrophotometry, Blood gas analyzers, Electrolytes analyzers. Therapeutic and Prosthetic Devices: pacemakers and defibrillators, Pacemaker analyzers cardiac assist devices, Hemodialysis, Lithotripsy, Ventilators, Anesthesia Machines, Infant Incubators, Drug Delivery Devices, Instruments for Surgery. Pre-requisite(s): BME 410. Co-requisite(s): BME 413.

BME 413-Biomedical Instrumentation II Lab 1(0-0-3): This laboratory-based course is designed to develop hands-on experimental skills relevant to the design and construction of biomedical instrumentation commonly used to acquire biomedical signals including aspects of signal processing, micro-computer interfacing, and simple software development. Teamwork and written communication skills are emphasized through laboratory report organization, documentation of results, error analysis and interpretation of findings. Co-requisite(s): BME 412.

BME 414-Biomedical Digital Signal Processing 3(4.5-0-0): This course is designed for senior level students. The objective of this course is to introduce the main techniques for the analysis of continuous and discrete signals including Laplace, Fourier and Z Transforms and apply them to analyze biological signals. Topics covered include signal acquisition and sampling; Nyquist rate; signal averaging; noise removal and signal compensation; discrete-time system analysis; Z transform; discrete and fast Fourier transform; transfer functions and digital filtering; Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) systems. Computer programming software such as Matlab will be used for the course assignments to analyze biological systems and design different types of filters. Pre-requisite(s): Engr 105 & BME 314.

BME 416-Introduction to BioMEMS and Bionanotechnology 3(4.5-0-0): The objective of the course is to expose students to biomedical MicroElectroMechanical Systems (MEMS) and

Nanotechnology, and to teach them fundamental principles of MEMS applications in biology and medicine. Topics covered include MEMS and nanotechnology, its application to biotechnology/biomedicine. Introduction to scaling laws as applied toward living systems and artificial devices; micro- and nanofabrication; biosensors and actuator principles; drug delivery; implantable systems; micro-total- analysis systems and lab-on-a-chip devices; minimally invasive surgery; detection and measuring systems; DNA, and protein microarrays; emerging applications in medicine. Pre-requisite(s): BME 202 & BME 220.

BME 420-Prosthetic Systems for Biomedical Engineering 3(4.5-0-0): Applying biomechanics of human movement to design and evaluate artificial devices intended to restore or improve movement loss due to disease or injury. Topics include motion analysis; gait analysis and electromyogram (EMG) and their measurement techniques. Artificial limbs; joint replacement & models of muscle and tension will be covered as well with the biomaterials used and their biocompatibility. Matlab projects will be assigned to demonstrate the concepts learned in this course. Pre-requisite(s): Engr 105, BME 304 & BME 320.

BME 430-Biomedical Image Processing 2(3-0-0): Medical image processing and analysis techniques: image enhancement and filtering in spatial and frequency domains, image restoration, image compression and archiving, segmentation, and registration. Common image characteristics such as Signal-to-Noise Ratio (SNR), resolution, contrast and Contrast-to-Noise ratio (CNR) will be covered as well. Concepts learned in this course will be demonstrated throughout projects and assignments utilizing computer programs such as Matlab. Pre-requisite(s): BME 314.

BME 432-Biomedical Data Processing, Archiving, and Communication 3(4.5-0-0): Data acquisition, digitization, storage and recovery. Review of image digitization, compression, enhancement and storage (archiving). Introduction to Picture archiving and communication System; Components of PACS; PACS Infrastructure; Network terminology; types of workstations; the relationship of a Radiology Information System (RIS) and/or a Hospital Information System (HIS) to PACS; interfaces and languages such as DICOM and HL-7 will be addressed. Pre-requisite(s): BME 430.

BME 440-Management of Healthcare Technology 3(4.5-0-0): Driven by ever-evolving technological advancements, healthcare institutions must continuously adapt them in order to provide optimal patient care. The proliferation of cutting-edge procedures in the Hospital call for the development of expertise in the management of Healthcare Technology. Management of Healthcare Technology ensures that the equipment and systems used in patient care are safe, operational, and properly configured to meet the mission of the healthcare; that the equipment is used in an effective way consistent with the highest standards of care.

Description: Management concepts of Healthcare Technology; Introduction to the codes, standards, ethical issues and regulations governing Healthcare Technology practices; Implications of Safe Medical Device Act (SMDA); Impact of regulatory agencies' (SFDA, JC etc.) requirements on the operations of the Healthcare Technology Management (HTM) program; Development of related policies and procedures govern activities such as the selection, planning, and acquisition of medical devices for their safe use; Patient Safety and Safety programs; infection control; Types of Contracts and contract negotiation; Development and operation of a Healthcare Technology Management/Clinical Engineering Department in a Hospital. Pre-requisite(s): BME 412.

BME 442-Information Technology for Biomedical Engineer 3(4.5-0-0): Integration of Information technology and Biomedical Engineering. Introduction to networking, communications, and information infrastructures in medical environment. Exposure to basic concepts related to networking at several levels: low-level (TCP/IP, services), medium-level (network topologies), and high-level (distributed computing, Web-based services) implementations. Commonly used medical communication protocols (HL7, DICOM) and current medical information systems (HIS, RIS, PACS). Advances in networking, such as wireless health systems, peer-to-peer topologies, grid/cloud computing. Introduction to security and encryption in networked environments. Pre-requisite(s): Engr 105.

BME 444-Medical Device Innovation and Entrepreneurship 3(4.5-0-0): This course provides a foundation course for those interested in developing medical devices and associated technologies. Topics include: innovation models, risks, costs and rewards; product development and new product management; product failure; introduction to medical devices and their classification and nomenclature; healthcare needs assessment; new medical devices and healthcare delivery: industry, government, hospital and user perspectives; medical device innovation including funding and IP issues and design guidance for manufacturers; medical device regulations including harmonization; essential principles of safety and performance of medical devices; Council Directive 93/42/EC on Medical Devices; ISO13485 and ISO14971 standards; FDA's 510(k) review procedure for medical devices; product liability and non-conformance; reliability and the product development process; biotechnology innovation; engineering entrepreneurship. Pre-requisite(s): BME 410.

BME 450-Senior Design I 2(3-0-0): This is the first course of a two-semester sequence of senior capstone design. It provides students with experience in the process and practice of biomedical component/system design from concept through final design. Project

management techniques, SFDA requirements for medical device design, intellectual property, ethical and human research subject considerations will also be covered. Emphasis will be on teamwork, project management, testing through simulation or prototype, oral and written communications. Pre-requisite(s): BME 410.

BME 452-Senior Design II 2(3-0-0): Continuation of BME 450 – Senior Design I. Pre-requisite(s): BME 450.

BME 460-Special Topics in Biomedical Engineering 3(4.5-0-0): Topics determined by the course instructor in consultation with the department chair. Pre-requisite(s): BME 410.
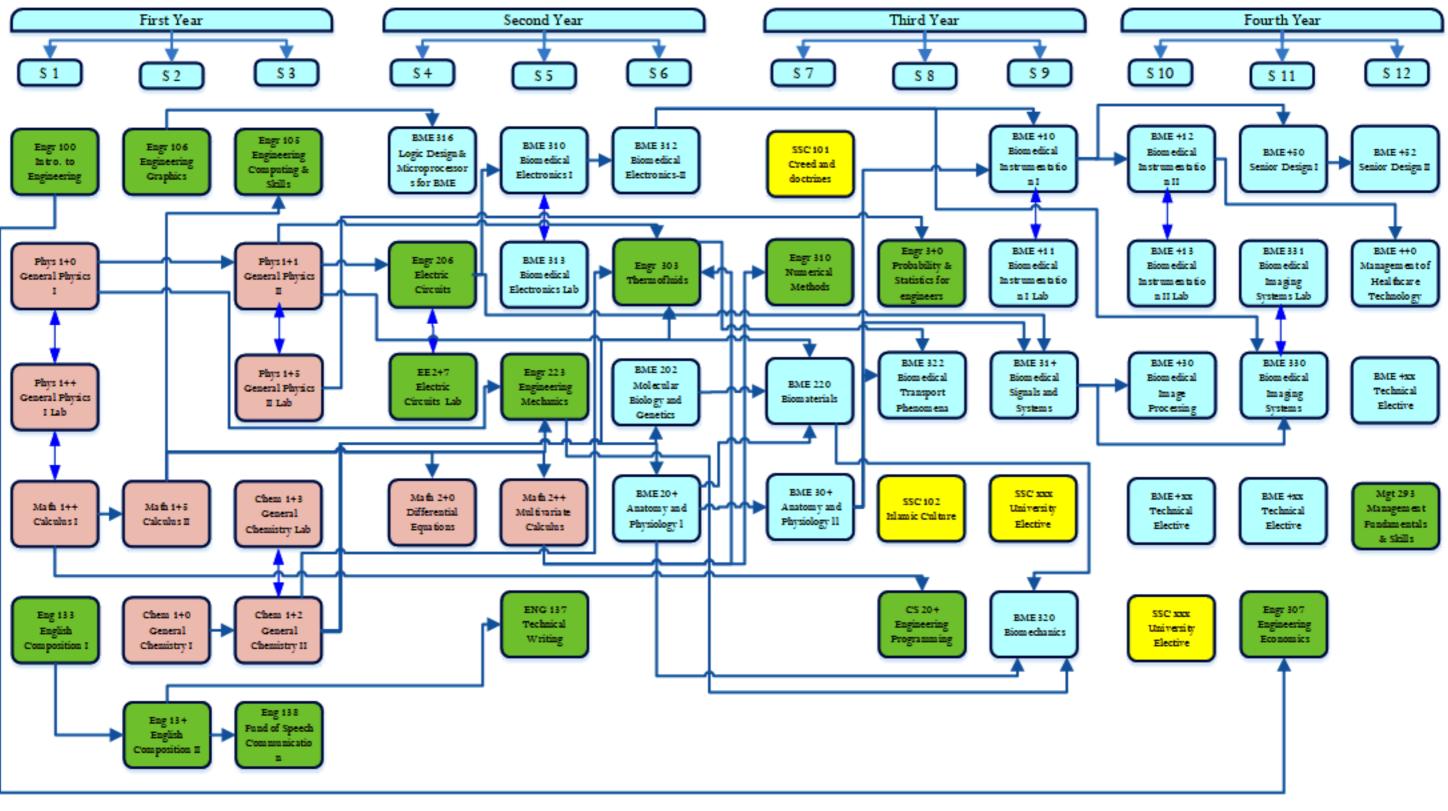
BME 462-Undergraduate Research in Biomedical Engineering 3(4.5-0-0): Individual research projects for students with honors classification. It requires prior approval of, and arrangement with, a faculty research advisor. Pre-requisite(s): BME 322.

Biomedical Engineering BSc Program

King Faisal University — ENGINEERING KFU — Uniqueness – Partnership – Success

First Year
S 1 | S 2 | S 3

Second Year
S 4 | S 5 | S 6

Third Year
S 7 | S 8 | S 9

Fourth Year
S 10 | S 11 | S 12

First Year
- Engr 100 Intro. to Engineering
- Engr 106 Engineering Graphics
- Engr 105 Engineering Computing & Skills
- Phys 1+0 General Physics I
- Phys 1++ General Physics I Lab
- Math 1++ Calculus I
- Math 1+5 Calculus II
- Chem 1+3 General Chemistry Lab
- Eng 133 English Composition I
- Chem 1+0 General Chemistry I
- Chem 1+2 General Chemistry II
- Eng 13+ English Composition II
- Eng 138 Fund of Speech Communication

Second Year
- BME 316 Logic Design & Microprocessors for BME
- Phys 1+1 General Physics II
- Phys 1+5 General Physics II Lab
- Engr 206 Electric Circuits
- EE 2+7 Electric Circuits Lab
- Engr 223 Engineering Mechanics
- Math 2+0 Differential Equations
- Math 2++ Multivariate Calculus
- ENG 137 Technical Writing

Middle courses
- BME 310 Biomedical Electronics I
- BME 312 Biomedical Electronics-II
- BME 313 Biomedical Electronics Lab
- Engr 303 Thermofluids
- BME 202 Molecular Biology and Genetics
- BME 220 Biomaterials
- BME 20+ Anatomy and Physiology I
- BME 30+ Anatomy and Physiology II
- Engr 310 Numerical Methods
- Engr 3+0 Probability & Statistics for engineers
- SSC 101 Creed and doctrines
- SSC 102 Islamic Culture
- SSC xxx University Elective
- CS 20+ Engineering Programming
- BME 320 Biomechanics

Third/Fourth Year
- BME +10 Biomedical Instrumentation I
- BME +11 Biomedical Instrumentation I Lab
- BME 322 Biomedical Transport Phenomena
- BME 31+ Biomedical Signals and Systems
- BME +12 Biomedical Instrumentation II
- BME +13 Biomedical Instrumentation II Lab
- BME +30 Biomedical Image Processing
- BME +xx Technical Elective
- BME +50 Senior Design I
- BME 331 Biomedical Imaging Systems Lab
- BME 330 Biomedical Imaging Systems
- BME +xx Technical Elective
- BME +52 Senior Design II
- BME ++0 Management of Healthcare Technology
- BME +xx Technical Elective
- SSC xxx University Elective
- Engr 307 Engineering Economics
- Mgt 293 Management Fundamentals & Skills

Legend
- Pre-requisites
- Co-requisites
- Department Requirements
- College Req. Inside college
- College Req. Out of college
- University Requirements

Lab Facilities

There are six laboratories for the Biomedical Engineering Program.

Electric Circuits Laboratory

The Circuits Lab is located in Building 11 basement (Room 12). The lab is equipped with various types of resistors, variable rheostats, inductor banks, capacitor banks, dc and ac power supplies, switches, lamp boards, ammeters, voltmeters, analog and digital Watt-meters, function generators, oscilloscopes, NI ELVIS electronic devices, etc. In the **Electric Circuits laboratory (EE 247)** classes, students are taught how to build electric circuits, safety rules of electric circuits, installation of common household appliances and how to write technical reports. The students also verify different electric circuit and network theorems e.g., KCL, KVL, mesh, node, Y-D and D-Y transformation, Thevenin's, Norton's, maximum power transfer and superposition theorems, etc. They also construct phasor diagram of the circuits from the experimental data, determine mutual inductance for the coupled circuits, find the series and parallel resonance frequency of ac circuits, types of filters and quality factors of the inductance coil, measure the ac power in the single phase and three phase circuits, etc.

Biomedical Electronics Laboratory

The Biomedical Electronics Lab is located in Building 11 basement (Room 12). In the **Biomedical Electronics Lab (BME 313)**, the students study electronics through experimentation. Students use standard laboratory equipment to analyze the behavior of basic electronic devices and to design and construct simple circuits containing these devices, such as Diode Characteristics, Half wave and full wave Rectification, BJT Transistors, MOSFET Transistors, etc. In addition, they will have the ability to use electronic test and measurement instruments and software, such as oscilloscopes, function generators, etc.

Computing Labs

There are two rooms in Building 59 dedicated to the computer labs. Room 3118 has 30 PC's with AutoCAD 2018 and MATLAB. An additional room (number 3120) has 25 PC's with MATLAB and internet accessibility for the students' use.

Engineering Computing & Skills (Engr 105) gives an introduction of MATLAB programming language. It is designed to give students fluency in MATLAB programming language. Problem-based MATLAB examples have been given in simple and easy way to make the learning fast and effective.

Engineering Graphics (Engr 106) laboratory focuses on the AutoCAD programming. Students are taught on the know how's of Basic geometric constructions. Technical drawing. Computer Aided Design, CAD. Components description and methods of using CAD systems. CAD system tasks. Basics of construction and making documentation using computers.

Biomedical Instrumentation I and II Lab

The Biomedical Instrumentation Laboratory is in Building 11 basement (Room 13). The lab has 19 PCs, a data projector and a copier. This laboratory-based course **(BME 411 and BME 413)** is designed to help students develop hands-on experimental skills relevant to the design and construction of biomedical instrumentation commonly used to acquire biomedical signals including aspects of signal processing, microcomputer interfacing, and simple software development. The lab is equipped with ELVIS II or MyDaq.PC and controlled via original virtual instruments (VIs) developed with the LabVIEW programming environment.

Biomedical Imaging Systems Lab

The Biomedical Imaging Systems Laboratory is in Building 11 basement (Room 11). The lab has 10 PCs with MATLAB and a projector. In this laboratory-based course **(BME 331),** the students use various image processing tools available in MATLAB software to analyze simulated and/or real medical imaging data.

Department Contact

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