# Course Syllabi

# Course Syllabus

## BMT 222
## Applied Mathematics for Biomedical

1. Course number and name: BMT 222 / Applied Mathematics for Biomedical Technology I

2. Credits and contact hours: 2 credit hours

3. Instructor's name: Mohammad Nisar

4. Text book, title, author, and year:

    - Books or notes: Peter K. F. Kuhfittig, "Basic Technical Mathematics with Calculus", Wadsworth Inc., 1989.

    - Anthony Croft, Robert Davison, "Mathematics for Engineers: A modern interactive approach", Addison- Wesley, 2003.

    - other supplemental materials:

        - Lecture notes (available on LMS system)

5. Specific course information

    a. brief description of the content of the course:

    This course covers fundamental mathematical concepts. Topics include Solution of linear and quadratic equations, Factoring and partial fraction, Trigonometric functions, Logarithmic and exponential functions, Vectors and oblique triangles, Complex numbers, Derivatives of algebraic and trigonometric functions and application of differentiation, Maclaurin and binomial Series

    b. prerequisites or co-requisites:

    Pre-requisites: ending preparatory year
    Co-requisites: NA

    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

a. specific outcomes of instruction:

This course is intended to provide basic knowledge and understanding of the fundamentals of mathematics. The student should develop the ability to learn and

apply several approaches used to solve engineering problems. They develop the ability to be able to solve system of linear and quadratic equations, differentiation and its application. The students should extend their problem-solving abilities.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of fundamental concepts in algebra, Solution of simultaneous, including the concepts of matrices and determinants | a, b, f |
| 2 | Students will demonstrate ability to solve quadratic equations using different methods including factoring, completing the square and using the quadratic formula, using sine and cosine laws to solve problems | a, b, f |
| 3 | Students will demonstrate an understanding of trigonometric, logarithmic, and exponential functions and their applications. Apply trigonometric identities to solve trigonometric equations | a, b, f |
| 4 | Students will demonstrate an understanding of the mathematical expressions and equations involve fraction, and use of partial fraction | a, b |
| 5 | Students will demonstrate ability to use and manipulate problems involving complex numbers | a, b |
| 6 | Students will demonstrate an understanding of the concepts of computing derivatives of algebraic, and trigonometric functions and application of differentiation | a, b |
| 7 | Students can expand different function using Maclaurin and binomial series. | a, b |

c. Brief list of topics to be covered

| Topics |
|---|
| A Review of some fundamental concepts in algebra |
| Solution of simultaneous linear equations using determinants etc., |
| Factoring and fraction, partial fraction |
| Solution of quadratic equations and quadratic formula |
| Trigonometric functions and identities, Euler’s identity |
| Logarithmic and exponential functions and their graphical representation |
| Vectors and oblique triangles using sine and cosine laws |
| Complex numbers |
| Derivatives of algebraic and trigonometric functions, |
| Maclaurin and binomial Series, |

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Midterm-1 | 5 | 20 % |
| b. | Midterm-2 | 9 | 14 % |
| c. | Midterm-3 | 14 | 20 % |
| d. | Assignments / quizzes | | 3 % / 3 % |
| e. | Final exam | 16 | 40 % |

# Course Syllabus

## BMT 223
## Applied Mathematics for Biomedical

1. Course number and name: BMT 223/Applied Mathematics for Biomedical Technology II

2. Credits and contact hours: (2 + 0) credit hours, (2 + 0) contact hours

3. Instructor's name: Dr. Mohamed Zoubir A. Bendjaballah

4. Text book, title, author, and year:

   - Books or notes:
     - Basic Technical Mathematics with Calculus, P. K. F. Kuhfittig, Wadsworth Inc., 1989
     - Applied Engineering Mathematics, Xin-She Yang, Cambridge International Science Publishing, 2007

   - Other supplemental materials:
     - Introduction to Applied Mathematics, A. Parks, CreateSpace Independent Publishing Platform, 2014
     - Wolfram Mathematica Online

5. Specific course information
   **a.** Brief description of the content of the course:
   This course covers fundamental mathematical concepts. starting from an overview on calculus, techniques and applications of differentiation and integration. The second part of the course deal with differential equations of the $1^{st}$ and 2 order, the Laplace transforms in general and how such transforms are used to solve various differential equations.

   **b.** Prerequisites or co-requisites:
   Pre-requisites: BMT 222
   Co-requisites: None

   **c.** Indicate whether this course is a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course
   a) Specific outcomes of instruction:

Upon successful completion of this course, the students will:

1. be able to apply the concepts and theories learned in this course to solve application problems that include curve sketching,
2. understand the concepts and rules of differentiation and integration,
3. know different techniques for finding derivatives and antiderivatives,
4. understand some basic definitions and terminology associated with differential equations and their solutions,
5. use direct integration, separation of variables and the integrating factor methods to solve first-order linear equations
6. solve homogeneous and inhomogeneous linear constant-coefficient second-order equations
7. compute the Laplace transform of a continuous function, find the inverse Laplace transform by partial fractions and use the Laplace transform to solve constant-coefficient differential equations with initial conditions.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of fundamental concepts of calculus | b |
| 2 | Students will become proficient in computing derivatives, interpret the findings and use their applications | b, f |
| 3 | Students will know how to compute definite and indefinite integrals, calculate areas bounded by curves and find the location of center of mass and moments of inertia | b, f |
| 4 | Students will understand the basic concepts of differential equations and become aware of their classifications | b |
| 5 | Students will demonstrate an ability to solve some types of first- and second-order differential equations | f |
| 6 | Student will become capable of computing the Laplace transform of a continuous function, find the inverse Laplace transform and convert the differential equation into and algebraic equation prior to finding the solution for a given the initial conditions | b, f |

c. Brief list of topics to be covered

| Topics |
|---|
| Overview on Calculus. Curve sketching, domain and limits. |
| Techniques and applications of differentiation |
| Integration: techniques and applications |
| Basic concepts of differential equations |
| Solving first-order linear differential equations |
| Solving second-order constant-coefficients linear differential equations |
| The Laplace and inverse Laplace transforms, solving differential equations using Laplace transform |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | Four quizzes (15 min) each | Not made known to students | 4x5% = 20% |
| 2 | First Periodical Exam (90 min) | Week 7 | 20% |
| 3 | Second Periodical Exam (90 min) | Week 12 | 20% |
| 4 | Final Exam | Refer to the final exam schedule | 40% |

# Course Syllabus

## BMT 224
## Applied Physics for Biomedical Technology

1. Course number and name: BMT 224/ Applied Physics for Biomedical Technology
2. Credits and contact hours: (3 + 1) credit hours, (3 +2) contact hours

3. Instructor's name Mohammad Nisar

4. Text book, title, author, and year:

- Books or notes: David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics Extended", 10th Edition Published by Wiley (2015)

- Other supplemental materials:

- Paul E. Tippens, "Physics", 7th Edition, McGraw-Hill, 2005.
- Lecture notes available on LMS system

5. Specific course information

a. brief description of the content of the course:

This course covers fundamentals of basic physics using algebra and trigonometry as tools. Topics include Units and dimensions, Vectors, Gradient, divergence, and curl, Maxwell equations, Thermodynamics, Work, energy, and power, Fluid mechanics, Sound, Ultrasound: applications in medical, Atomic physics:, spectroscopy, ionizing radiation, Properties of nucleus

b. Prerequisites or co-requisites:

Pre-requisites: ending preparatory year
Co-requisites: NA

c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

a. Specific outcomes of instruction:

This course is intended to provide knowledge of basic physics principles and applications. The students should develop the ability to use the basics principles of physics in biological systems. They should be able to apply the basics of

thermodynamics, fluid, sound and radiation physics in bio-medical phenomena. Also the students should extend their problem solving abilities.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of basics of vector analysis, including the concepts of addition and multiplication of vectors. | a, b |
| 2 | Students will demonstrate ability to solve problems using different methods of analysis including Gradient, divergence, and curl of a vector, Maxwell equations | a, b |
| 3 | Students will demonstrate an understanding of error propagation, temperature and expansion, work, energy, and power. | a, b |
| 4 | Students will demonstrate an understanding of the ultrasound, Doppler-effect and their applications in medical field | a, b |
| 5 | Students will demonstrate ability to solve the Hydrogen atom and the use of atomic physics and spectroscopy concepts in technology | a, b |
| 6 | Students will demonstrate an understanding of the concepts of nuclear physics, uses of isotopes, radio-activity, Half-life, nuclear fission, and fusion. | a, b |
| 7 | Students can understand nature and properties of ionizing radiation, their used in medicine and their interaction with matter | a, b |
| 8 | Most of the topics are targeted in practical sessions in laboratory. | c |

c. Brief list of topics to be covered

| Topics |
|---|
| Units and dimensions of different physiological parameters, Vectors and scalars, multiplication of vectors |
| Gradient, divergence, and curl of a vector, Maxwell equations, electrostatics, |
| Error propagation, uniformly accelerated motion, solution of acceleration problems, Gravity |
| Temperature and expansion, Heat transfer mechanisms: Measurement of temperature, Linear, area, and volume expansion, The abnormal expansion of water |
| Work, energy, and power |
| Fluids at rest, Density, Pressure, Fluid pressure, Examples of pressure in human organs, Measuring pressure, Archimedes' principle. |
| Sound: Production of sound waves, Speed of sound, Resonance, Interference and beats, Doppler effect, Ultrasound: applications in medical |
| Atomic physics: Hydrogen atom, spectroscopy |
| Nature and properties of ionizing radiation, their used in medicine and their interaction with matter. |
| Nuclear physics and the nucleus: atomic mass unit, Isotopes, The mass defect and binding energy, Radio-activity, Half life, Nuclear fission, Nuclear fusion. |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Midterm-1 | 7 | 20 % |
| b. | Midterm-2 | 13 | 15 % |
| c. | Practical exam | 14 | 10% |
| d. | Practical reports | Bi-weekly | 10% |
| e. | Assignments | | 5% |
| f. | Final exam | 16 | 40 % |

# Course Syllabus
# BMT 225
# MEASUREMENTS

1. Course number and name: BMT 225/ MEASUREMENTS

2. Credits and contact hours: (1 + 1) credit hours, (1 +2) contact hours

3. Instructor's name: Dr. ALI S. ALANAZI

4. Text book, title, author, and year:

   - Books or notes: Alan S. Morris "Measurement and Instrumentation Principles" Butterworth-Heinemann, 1st -ed, 2001 (ISBN 0 7506 5081 8).

   - other supplemental materials:

   - Fundamentals of Materials Science and Engineering:
   - An Integrated Approach W.D. Callister, Jr. and D. G. Rethwisch 8th Edition: John Wiley and Sons, Inc. (2010).

   - Course materials are uploaded on the LMS:
   - ( https://lms.ksu.edu.sa/webapps/portal/frameset.jsp)
   - https://www.khanacademy.org/

5. Specific course information

   a. Brief description of the content of the course:
      The purpose of this course is to present an overview of fundamental measurements. Topics include; Measurement units and SI units definitions. Elements of a measurement system such as (Measured, Sensor, Signal Conditioning, Output Display, Auxiliary Elements, Signal Filtering). Instrument types such as Active, passive, Null-type, deflection-type, Analogue and digital instruments. Static Characteristics of instrument such Accuracy and inaccuracy (measurement uncertainty), Precision, repeatability, reproducibility.

   b. prerequisites or co-requisites:
      Pre-requisites: NA
      Co-requisites: NA
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

a. specific outcomes of instruction:

1. To study and define the knowledge of measurement units and SI units definitions.;
2. To study and define a knowledge of Elements of a measurement system
3. To study the introduction of Instrument Static Characteristics;
4. To study and solve broadly-defined Laplace and Fourier analysis;
5. To study and demonstrate the ability to apply written, oral, graphical communication effectively

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Considered ABET outcomes:

1. Ability to select and define the knowledge, techniques, skills of measurement units and SI units' definitions;
2. Ability to select and define a knowledge of measurement element systems;
3. Ability to identify, analyze, and solve broadly-defined measurement mathematics in time domain and frequency domain.;
4. Demonstrate the ability to apply written, oral, graphical communication effectively

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of basic measurement science and engineering characterization and properties. | a |
| 2 | Students will demonstrate an understanding the applications of measurement and measurement tools. | a, b |
| 3 | Student will demonstrate a basic understanding of the application of the measurement tools and its mathematic. | b, c |
| 4 | Students will be able to conduct standard tests and errors calculation; to conduct, errors types of measurement. | c |

7. Brief list of topics to be covered

| Topics |
|---|
| Measurement units and SI units' definitions. |
| Elements of a measurement system. |
| Instrument types. |
| Instrument Static Characteristics. |
| Mid Term Exam. |
| Instrument dynamic characteristics (time domain). |
| Laplace and Fourier analysis. |
| Instrument dynamic characteristics (Frequency domain). |

# Course Syllabus
# BMT 227
# Computer Programming

1. Course number and name: BMT 227/ Computer Programming
2. Credits and contact hours: (1 + 1) credit hours, (1 +2) contact hours
3. Instructor's name: Abdullah BenOmran
4. Text book, title, author, and year:
    a. Books or notes:
        - Teach yourself C++ in 21 days, Jesse Liberty and Bradley Jones, 2005.
    b. Other supplemental materials:
        - Lecture notes available on LMS system
5. Specific course information
    a. brief description of the content of the course:

        This course will provide an introduction to the C++ programming language and its usage. After attending this course students will have acquired the basic skills in programming in C++ and an understanding of the ideas of object oriented programming. Topics covered in this course include an introduction to classes and objects, class variables, constructors and functions, overloaded constructors and functions, public and private access to variables and functions, arithmetic operators, simple input and output, comparison operators and the use of conditional and iterative control statements, use of library functions and the creation of user defined functions, introduction to pointers, introduction to arrays, accessing arrays using both subscripts and pointers.
    b. prerequisites or co-requisites:

        Pre-requisites: None
        Co-requisites: NA
    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required
6. Specific goals for the course
    a. specific outcomes of instruction:

Upon completing BMT227, students should have the following capabilities:
Able to design a C++ program to perform specific tasks.
Able to examine program codes to eliminate errors and warning.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | a. an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical technology to include the application of circuit analysis, analog and digital electronics, microcomputers, biomechanics, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment. | a |
| 2 | an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes. | c |
| 3 | a commitment to quality, timeliness, and continuous improvement. | k |

c. Brief list of topics to be covered

| Topics |
|---|
| The Parts of a C++ Program:<br>A Simple Program, cout, comments, using functions. |
| Variables and Constants:<br>Storing data in memory, size of integers, signed and unsigned, variable types, defining variables, creating variables, short and long variables, wrapping around, characters, and enumerated constants. |
| Expressions and Statements:<br>Using white spaces, assignment operators, mathematical operators, incrementing and decrementing, prefixing and postfixing, operator precedence, nesting, the nature of truth, the els statement, advanced if statement, using logical operators, the conditional operator. |
| Functions:<br>Return values, parameters, arguments. Declaring and defining functions, function prototype, Variables scope, and default parameters. |
| Basic Classes:<br>Declaring a class, defining an object, private versus public access. |
| Program Flow:<br>Looping, goto, using while loops, do…while loops, |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | **First Midterm** | 7 | 15% |
| b. | **Second Midterm** | 11 | 15% |
| c. | **Practical** | | 30% |
| d. | **Final** | | 40% |
| e. | | | |

# Course Syllabus

## BMT 228
## Introduction to Biomechanics

1. Course number and name: BMT 228/ Introduction to Biomechanics

2. Credits and contact hours: (2 + 0) credit hours, (2 + 0) contact hours

3. Instructor's name: Dr. Wissal Mesfar

4. Text book, title, author, and year:

    a. Books or notes:
    - Susan, Hall, "Basic Biomechanics", 6th Edition, 2012.
    - Lecture notes (available on LMS system)

    b. Other supplemental materials:

5. Specific course information
    a. Brief description of the content of the course:
    This course presents the fundamentals of biomechanics starting by an Introduction to Biomechanics, two chapters on kinematic and kinetic concepts to analyze human motion including presentation of the quantitative and qualitative approaches to analyze human motion and following by a chapter dealing with the use of static equilibrium equations to solve problems applied to the different human joints, determination of the mechanical advantage and the determination of the center of gravity of multi-segment systems. Finally, two chapters will be devoted to the presentation of the biomechanical aspects of the bone and muscle structures.

    b. Prerequisites or co-requisites:
    Pre-requisites: None
    Co-requisites: None
    Indicate whether this course is a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course
    a. Specific outcomes of instruction:
    By the end of this course, the student should demonstrate the ability:

    - to understand the different biomechanical concepts to analyze human motion.

- identify the biomechanical concepts and tools should be used to analyze a biomechanical problem.
- to solve biomechanical static problems related to human joints and establishes the equilibrium equations to analyze the biomechanics of the joint kinetically.
- to describe the bone anatomy (macroscopic and microscopic), the processes involved in the normal growth and maturation of bone, and explain how the material constituents and structural organization of bone affect its ability to withstand mechanical loads as well as to describe the effects of exercise and of weightlessness on bone mineralization and the bone remodeling process.
- to describe the skeletal muscles function, anatomy of the muscles, the effects of the force–velocity and length–tension relationships and of the electro-mechanical delay on muscle function.
- to identify the basic behavioral properties of the musculotendinous unit, explain the relationships of fiber types and fiber architecture to muscle function. Ability to discuss the concepts of strength, power, and endurance from a biomechanical perspective.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Ability to select and define the knowledge, techniques, skills, and modern tools of biomechanics. | a, b |
| 2 | Ability to describe the different concepts of biomechanics to analyze the human motion. | a |
| 3 | Ability to identify, analyzes, and solves broadly-defined biomechanical problems. | b, f |
| 4 | Ability to talk about biomechanical topics, write a report and develop a presentation. | g |

c. Brief list of topics to be covered

| Topics |
|---|
| Introduction of the course - What is Biomechanics |
| Kinematic Concepts for Analyzing Human Motion |
| Kinetic Concepts for Analyzing Human Motion |
| Biomechanics of Resistance Exercise |
| The Biomechanics of Human Bone Growth and Development |
| The Biomechanics of Human Skeletal Muscle |
| Presentation of Biomechanical Project by Students |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | At the end of each chapter, one assignment should be done after chap 1, 2, 3 and 5 and two assignments should be done after chapter 4. | One week after the end of the chapter | All the assignment accounts for 25% |
| b. | 1 Mid term | Week 9 | 25% |
| c. | Report and Oral presentation on a Biomechanical subject should be submitted at the last lecture | Week 14 | 10% |
| d. | Final Exam | Please refer to the Final exam schedule | 40% |

# Course Syllabus

## BMT 232
## Mechanical Biomedical Equipment

1. Course number and name: BMT 232 / Mechanical Biomedical Equipment

2. Credits and contact hours: (2 + 1) credit hours, (2 + 2) contact hours

3. Instructor's name: Dr. Wissal Mesfar

4. Text book, title, author, and year:

    a. Books or notes:
        - Mechanics of Materials, 6th Edition, James M. Gere, 2004
        - Bar-Meir, Genick, "Basics of Fluid Mechanics", Version 0.3.4.0, 2013.
        - Lecture notes Syllabus of Lab (available on LMS system)

    b. Other supplemental materials:

5. Specific course information
    a. Brief description of the content of the course:
    This course is divided into two parts. The first part provides students with basic knowledge in continuum mechanics principles, internal forces in systems using free body diagram (FBD) technique with special application on predicting internal forces in the human joints, basic concept of stress and strain, establishment of the relationship between the stress and strain, development of the generalized hook's law matrix, analyzing the stress by using Mohr's circle for plane stress and plane strain following lectures from strain gages.
    The second part of this course provides students with basic knowledge in fluid statics principles stressing on the pressure calculation and measurement techniques as well as with basic knowledge fluid dynamics principles and solving problems of fluid in motion by using Bernoulli's equation.

    b. Prerequisites or co-requisites:
    Pre-requisites: BMT 224
    Co-requisites: None

    c. Indicate whether this course is a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

a. Specific outcomes of instruction:

By the end of this course, the student should be able to demonstrate the ability:

- to define the knowledge related to the axial loading, the concept of stress and strain as well as the stress analysis by using Mohr's circle technique.
- to apply the concept of free body diagram 'FBD' and its application to graphically estimate the contact forces in human joints.
- to use theoretical background to analyze stresses by using Mohr's circle.
- to use the appropriate formulation to resolve fluid mechanics-related problems in statics and dynamics conditions.
- to use the tensile test experimentation to find the stress-strain curve, define the elastic and plastic regions and calculate the modulus of Elasticity.
- to use the appropriate experimentation to measure the fluid properties.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Ability to define the knowledge related to solid mechanics and concept of free body diagram, concept of stress and strain and their relationship, and analyze the mechanical stress by using Mohr's circle technique. | b |
| 2 | Ability to apply the concept of free body diagram 'FBD' and its application to graphically estimate the contact forces in human joints. | b |
| 3 | Ability to conduct standard tests and measurements to define the stress-strain curve as well as to define fluid properties. | c |
| 4 | Ability to identify, analyzes, and solves broadly-defined problems related to stress analysis, fluid at rest and in motion. | f |

c. Brief list of topics to be covered

| Topics |
|---|
| Review of statics and introduction to mechanics of materials, free body |
| Normal stress and strain, mechanical properties of materials, elasticity and plasticity, linear elasticity, Hooke's Law, and Poisson's Ratio |
| Shear stress and strain, stresses on inclined sections, Generalized Hooke's Law, strain and stress tensors |
| Plane stress, principal stresses and maximum shear stresses, Mohr's Circle for plane stress, plane strain, strain gage, Mohr's Circle for plane strain. |

| |
|---|
| Introduction to fluid statics, Pascal's laws; Absolute and gauge Pressure; Pressure distribution for a fluid at rest; Pascal's principle; Vertical plane surfaces. Buoyancy, measurement of pressure differences- application to vertical and inclined manometer. |
| Introduction to fluid dynamics; kinematics of fluid; steady and unsteady flow; uniform and non-uniform flow; acceleration in fluids; flow classification; compressible and incompressible fluids; laminar vs turbulent flow; flow rate; discharge and mean velocity; continuity equation; Bernoulli equations; kinetic, potential, and pressure energies; applications to the Venturi Meter. |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Mid Term 1 examination | 8-9 | 15% |
| b. | Mid Term 2 examination | 14 | 15% |
| c. | Lab reports after each lab | | 30% |
| d. | 2 Lab Examinations | 13 | |
| e. | Final Exam | Please refer to the schedule of the final exams | 40% |

# Course Syllabus
# BMT 313
# BIOMEDICAL ELECTRONICS III

1. Course number and name: BMT 313/ BIOMEDICAL ELECTRONICS III
2. Credits and contact hours: (2 + 1) credit hours, (2 +2) contact hours
3. Instructor's name: Dr. Adham Aleid
4. Text book, title, author, and year:
    a. Books or notes: "operational amplifiers with Linear integrated circuit", Fourth edition, William Stanley, Pearson, 2001
    - other supplemental materials:
        - "Design with Operational Amplifiers and Analog Integrated Circuits" by Sergio Franco, McGraw Hill Higher Education, 2014
        - Lecture notes (available on my website and LMS system)
5. Specific course information
    a. brief description of the content of the course:
    This course introduces integrated circuits to students. It covers the fundamentals of operational amplifiers and their common configurations used for signal amplification purposes. Also, this course covers further applications of operational amplifiers in signal processing, signal generation and wave shaping.
    b. prerequisites or co-requisites:
    Pre-requisites: BMT 212
    Co-requisites: NA
    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required
6. Specific goals for the course
    a. specific outcomes of instruction:

- Understand, design and analysis operational amplifier-based integrated circuits and their applications in instrumentation.
- Understand the basics of operational amplifier and Integrated Circuits.

- Application of IC in medical instrumentation.
- Develop an ability to design and analyze electronic circuits.
- Expose the students to operational amplifier-based signal processing circuits.
- To be able to conduct standard tests and measurements; to conduct, and interpret experiments.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Understand, the basic knowledge required to design and analyze operational amplifier-based integrated circuits and their applications in medical instrumentation | a |
| 2 | An ability to properly using equipment needed to conduct standard tests and measurements to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes. | c |
| 3 | An ability to identify, analyze, and solve broadly-defined biomedical technology problems related to op-amp circuits. | f |

c. Brief list of topics to be covered

| Topics |
|---|
| Introduction (basic concepts) |
| Op-amp ideal characteristics |
| Op-amp analysis and design |
| Op-amp limitation and imperfection (dc) |
| Op-amp limitation and imperfection (ac) |
| Linear op-amp circuit (instrumentational) |
| Integrator and differentiator (I) |
| Integrator and differentiator (II) |
| Active filter (I) |
| Active filter (II) |
| Comparator (I) |
| Comparator (I) |
| Introduction (basic concepts) |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Lecture Quizzes | Continuous | 8% |
| b. | Midterm 1 | 7 | 16% |
| c. | Short Exam | 11 | 8% |
| d. | Topic presentation | 13 | 8% |
| e. | Lab report | Continuous | 10% |
| f. | Lab exam | 14 | 10% |
| g. | Final exam | 16 | 40% |

# Course Syllabus
# BMT 314
# BIOMEDICAL ELECTRONICS IV

1. Course number and name: BMT 314/ BIOMEDICAL ELECTRONICS IV
2. Credits and contact hours: (2 + 1) credit hours, (2 +2) contact hours
3. Instructor's name: Dr. Ali S Al-Mejrad
4. Text book, title, author, and year:
    a. Books or notes: Digital Systems: Principles & Applications by Ronald J. Tocci (12th Edition), 2017, Pearson Education
    b. other supplemental materials:
        - Website of text book publisher
5. Specific course information
    a. brief description of the content of the course:
    This course is intended to provide Introduction to the Digital and Analog Systems. Digital Number Systems & Codes, Digital Circuits, Parallel and Serial Transmission, Memory, Digital computers, Conversion of numbers, Parity Method for Error Detection. Logic Gates and Boolean Algebra, Boolean Theorems, DeMorgan's theorems. Combinational Logic Circuits, SOP & POS Forms, Algebraic Simplification, Designing combinational Logic Circuits, K Map Method, XOR, XNOR, Parity Generator and Checker, Troubleshooting Digital Systems, Characteristics of Digital ICs, Internal and External Digital IC Faults. Flip Flop (FF) and related Devices, S-C FF, J-K FF, D FF, asynchronous inputs, FF timing considerations, Shift registers, frequency division and counting, one-shot, troubleshooting FF circuits, Digital arithmetic, Digital system applications.
    b. prerequisites or co-requisites:
    Pre-requisites: BMT212
    Co-requisites: NA
6. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required
    a. Specific goals for the course
        a. specific outcomes of instruction:

1- an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical technology to include the application of circuit analysis, analog and digital electronics, microcomputers, biomechanics, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment.

Students select and apply the knowledge, techniques, and skills of digital electronics to digital system related activities

2- an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of biomedical systems.

Students select and apply knowledge of mathematics, science, engineering, and technology to digital system problems

3- An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.

Students conduct standard tests and measurements; conduct, analyze, and interpret experiments using digital system components

4- an ability to analyze, design, and implement biomedical systems, components or processes for broadly-defined engineering technology problems appropriate to program educational objectives.

Students design digital system components

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Considered ABET outcomes:

i. an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical technology to include the application of circuit analysis, analog and digital electronics, microcomputers, biomechanics, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment.

ii. an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability,

transform methods, discrete mathematics, or applied differential equations in support of biomedical systems.

iii. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.

iv. an ability to analyze, design, and implement biomedical systems, components or processes for broadly-defined engineering technology problems appropriate to program educational objectives.

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Students select and apply the knowledge, techniques, and skills of digital electronics to digital system related activities | a |
| 2 | Students select and apply knowledge of mathematics, science, engineering, and technology to digital system problems | b |
| 3 | Students conduct standard tests and measurements; conduct, analyze, and interpret experiments using digital system components | c |
| 4 | Students design digital system components | d |

c. Brief list of topics to be covered

| Topics |
|---|
| 1. Overview: Introduction to the course |
| 2. Introductory Concepts |
| 3. Number Systems And Codes |
| 4-5. Describing Logic Circuits |
| 6-8. Combinational Logic Circuits |
| 9-11. Flip Flops & Related Devices |
| 12. Digital Arithmetic |
| 13. Digital System Applications |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | **Midterm Exam I** | Week 8 | 20 % |
| 2 | **Midterm Exam II** | Week 14 | 20 % |
| 3 | **Quizzes** | Throughout semester | 3 % |
| 4 | **Participation** | Throughout semester | 2 % |
| 5 | **Practical (Laboratory)** | Throughout semester | 15 % |
| 6 | **Final Exam** | Final Exam Schedule | 40 % |

# Course Syllabus
# BMT 315
# Introduction to Bioelectrical

1. Course number and name: BMT 315/ Introduction to Bioelectrical Instrumentation
2. Credits and contact hours: (1 + 1) credit hours, (1 +2) contact hours
3. Instructor's name: Dr. Amir Said Al-Tinawi
4. Text book, title, author, and year:
    a. Books or notes: Biomedical Instrumentation and Measurements, L. Cromwell 2Ed paperback, Pearson India, 2015.
    b. other supplemental materials:
    - Lecture notes (available on my website and LMS system)
5. Specific course information
    a. brief description of the content of the course:
    Students completing this course will be able to recognize and define terms of biometrics, components of man-instrument system, problems encountered in measuring a living system, basic transducer principles, origin of bio-potentials, Introduction to ECG, EGG and EMG, biopotential electrodes and finally the general structure of biomedical instrument using one or two applications. This course is aligned with the laboratory work, which is typically taken in the same semester.
    b. prerequisites or co-requisites:
    Pre-requisites: BMT313/ Biomedical Electronics III
    Co-requisites: BMT314/ Biomedical Electronics IV
    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required
6. Specific goals for the course
    a. specific outcomes of instruction:
    This course is intended to provide knowledge and understanding of biometrics, design factors of biomedical devices, man-instrument system and problems encountered in measuring living system. The student should also develop the ability to recognize and define origins of different biopotentials, function of basic transducers and different biopotential signals and electrodes.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of basic biometrics, design factors of biomedical devices, and man-instrument system | a,b |
| 2 | Students will demonstrate an ability to recognize and define problems encountered in measuring living system | a,b |
| 3 | Students will demonstrate an understanding of the function of basic transducers | a,b |
| 4 | Students will demonstrate an ability to define the origin and genesis of different biopotentials | a,b |
| 5 | Students will demonstrate an understanding of the principle and use of different biopotential electrodes | a,b |
| 6 | All topics are targeted in practical sessions in laboratory. | c |

c. Brief list of topics to be covered

| Topics |
|---|
| Introduction to Biomedical Technology |
| Biometrics, Design factors of biomedical devices |
| Components of man-instrument system |
| Brief reminder of Body physiological systems |
| Problems encountered in measuring living system |
| Basic transducer principles (active, passive) |
| Origin of bioelectric potentials and physiological variables |
| Biopotential Electrodes |
| Electocardiogram, Electroencephalogram |
| Electromyogram, Electroretinogram, Electro-oculogram |
| Examples of Basic cardiovascular measurements |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | **Mid term I** | Week 8 | 14 % |
| 2 | **Mid term II** | Week 14 | 14 % |
| 3 | **Quizzes** | Throughout semester | 6 % |
| 4 | **Assignment and Presentation** | Week 10 to 13 | 6 % |
| 5 | **Practical (Laboratory)** | Throughout semester | 20 % |
| 6 | **Final Exam** | Final Exam Schedule | 40 % |

# Course Syllabus
# BMT 323
# Electrical Skills II

1. Course number and name: BMT 323 / Electrical Skills II
2. Credits and contact hours: (1 + 1) credit hours, (1 +2) contact hours
3. Instructor's name: Dr. Magdy G. Elghatwary
4. Text book, title, author, and year:
    a. Selected chapters and notes from different sources

- Other supplemental materials:

- Lecture notes (available on my website and LMS system)
- Website of text book publisher

5. Specific course information
    a. brief description of the content of the course:

    Students completing this course will be able to know the elements of circuit diagrams (resistances, capacitors, inductors, switches, power supplies different loads and logic and electronics devices. Students will know basic information about signal tracing, circuit troubleshooting and CMOS technology. This course is aligned with the laboratory work, which is typically taken in the same semester.

    b. prerequisites or co-requisites:

    Pre-requisites: BMT 226
    Co-requisites: NA

    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course
    a. specific outcomes of instruction:
    This course is intended to provide basic knowledge and understanding of the fundamentals of electric circuits design. The student should develop the ability to learn software program used to design electrical circuits, and develop printed circuit boards. The student should

develop the ability to tracing signal in electrical circuit, CMOS technology and basics of electrical circuit troubleshooting.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of basic theories of electric and electronic circuit analysis | a |
| 2 | Students will demonstrate ability to construct standard test and measurements for electrical circuits. All topics are targeted in practical sessions in laboratory. | c |
| 3 | Students have ability to design electrical circuits. Understanding the concepts of signal tracing, troubleshooting and CMOS technology | d |

c. Brief list of topics to be covered

| Topics |
|---|
| Basic electrical components symbols |
| Capacitors specifications |
| Printed circuit boards techniques |
| Signal tracing |
| Troubleshooting |
| Capacitors |
| CMOS technology |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | **Mid-term I** | 7 th week | 15 % |
| b. | **Mid-term II** | 12 th week | 15 % |
| c. | **Homework** | From 2 nd to 14 th week | 5% |
| d. | **Quizzes** | Throughout the semester | 5% |
| e. | **Practical** | 14 th week | 20% |
| f. | **End semester Exam** | 16 th -18 th week | 40% |

# Course Syllabus
# BMT 333
# Electric Machines in Medical

1. Course number and name: BMT 333/ Electric Machines in Medical Instrumentation

2. Credits and contact hours: 2 credit hours

3. Instructor's name: Mohammad Nisar

4. Text book, title, author, and year:

   a. Books or notes: Stephen J. Chapman, "Electric machinery Fundamentals", 4th Edition, McGraw-Hill, 2005

   b. E. Fitzgerald, " Electric machinery", 6th Edition, McGraw-Hill, 2003

   - other supplemental materials:
   - Lecture notes available on LMS system

5. Specific course information

   a. brief description of the content of the course:

   This course covers fundamental electric machinery concepts. Topics include Electromagnetic circuits, magnetic losses, production of force and the governing equations, phasor diagrams, concept of pole number and winding factor, principles of the basic machines types, like Linear, induction, synchronous, Dc machines and different types of single phase motors. Description, Concept of Operation, Torque Development, Operating characteristics, of synchronous and induction machines.

   b. prerequisites or co-requisites:

   Pre-requisites: BMT-225
   Co-requisites: NA

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

   a. specific outcomes of instruction:

   This course is intended to provide basic knowledge and understanding of the fundamentals of electrical machines. The student should develop the ability to learn and apply theory and principles of electromagnetism and

electromechanical energy conversion devices. They develop the Knowledge of operating principles of induction machines, synchronous machines and DC machines. The students should extend their problem solving abilities.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of electromagnetic circuits, magnetic losses, production of force and the governing equations. | a, b |
| 2 | Students will have concept of phasor diagram and use vector method for analysis of AC machines, characteristics for both generator and motor operations | a, b, f |
| 3 | Students will demonstrate an understanding of transformers: description, transformer tests, losses and ratings - The ideal and autotransformers | a, b |
| 4 | Students will have knowledge of the linear DC machine- as motor, and as a generator, starting problems with the linear machine | a, b, f |
| 5 | Students will demonstrate an understanding of the behavior of DC motors: geometry, fields, voltages, and currents. | a, b |
| 6 | Students will have knowledge of induction machines: description, concept of operation, torque development, operating characteristics, Synchronous machines: description, concept of operation, | a, b, f |
| 7 | Students can understand the circuits and working principle of single phase motors, stepper motors | a, b |

c. Brief list of topics to be covered

| Topics |
|---|
| Electromagnetic circuits, magnetic losses, permanent magnet, production of force and the governing equations |
| Phasor diagram and characteristics for both generator and motor operations |
| Transformers: description, transformer tests, losses and ratings - The ideal and autotransformers transformers |
| The linear DC machine- A simple example, as motor, as a generator, starting problems with the linear machine |
| DC motors: geometry, fields, voltages, and currents |
| DC motor: shunt – series - compound |
| Induction machines: Description, Concept of Operation, Torque Development |
| Synchronous machines: Description, Concept of Operation, Torque Development |
| Single phase motors |
| Special Motors, Stepper motors, Choppers |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Midterm-1 | 5 | 20 % |
| b. | Midterm-2 | 9 | 20% |
| c. | Midterm-3 | 14 | 20% |
| d. | Final exam | 16 | 40 % |

# Course Syllabus
# BMT 334
# Biomedical Imaging Equipment

1. Course number and name: BMT 334/ Biomedical Imaging Equipment
2. Credits and contact hours: (2 + 1) credit hours, (2 +2) contact hours

3. Instructor's name: Dr. Amir Said Al-Tinawi

4. Text book, title, author, and year:

    a. Books or notes: Jerry L. Prince, Jonathan M. Links, "Medical Imaging – Signals and Systems", 2 nd edition, 2015, Pearson
    b. other supplemental materials:
    - Lecture notes (available on my website and LMS system)

5. Specific course information

    a. brief description of the content of the course:

    Students completing this course will be able to demonstrate an understanding of the physics of different biomedical imaging modalities. Students will also demonstrate an ability to recognize and define the purpose, principle of operation, components, and technical specification of different types of imaging systems including projection radiography, computed tomography, planar scintigraphy, single-photon emission computed tomography, positron emission tomography, ultrasound and magnetic resonance imaging systems.

    b. prerequisites or co-requisites:

    Pre-requisites: BMT336/ Optical Biomedical Instrumentation

    Co-requisites: None

    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

    a. specific outcomes of instruction:

    This course is intended to provide basic knowledge and understanding of the different medical imaging systems. The student should develop the ability to recognize and define purpose, principle of operation, components, and technical specification of different medical imaging systems.

    b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of electromagnetic radiation physics and mathematical tools applied in image processing and analysis | b |
| 2 | Students will demonstrate an ability to recognize and define different medical imaging modalities and their medical purpose | a,b |
| 3 | Students will demonstrate an ability to recognize and define principle of operation and components of different medical imaging systems | a,b |
| 4 | Students will demonstrate an understanding of the technical specification of different medical imaging systems | a,b |
| 5 | All topics are targeted in practical sessions in laboratory. | c |

c. Brief list of topics to be covered

| Topics |
|---|
| Introduction: Physics of electromagnetic radiation, Imaging modalities |
| Projection Radiography |
| Computed tomography |
| Image Receptors |
| nuclear Medicine: Planar Scintigraphy |
| nuclear Medicine: Single-photon emission computed tomography |
| nuclear Medicine: Positron emission tomography |
| Ultrasound imaging systems |
| Magnetic resonance imaging |
| Physics of nuclear Medicine, Planar Scintigraphy |
| Single-photon emission computed tomography |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | **Mid term I** | Week 8 | 14 % |
| 2 | **Mid term II** | Week 14 | 14 % |
| 3 | **Quizzes** | Throughout semester | 6 % |
| 4 | **Assignment and Presentation** | Week 10 to 13 | 6 % |
| 5 | **Practical (Laboratory)** | Throughout semester | 20 % |
| 6 | **Final Exam** | Final Exam Schedule | 40 % |

# Course Syllabus
# BMT 335
# Mechanical Biomedical Instrumentation II

1. Course number and name: BMT 335 / Mechanical Biomedical Instrumentation II

2. Credits and contact hours: 3 (2 + 1) credit hours, 4 (2 +2) contact hours

3. Instructor's name: Dr. Mohammed Fayez Al Rez

4. Text book, title, author, and year:

   a. Books or notes: R. S. Khandpur, "Handbook of Biomedical Instrumentation", 3rd edition, 2014, McGraw-Hill Education.

   b. Other supplemental materials:
   - Lecture notes and power point slides (available on LMS website)

5. Specific course information

   a. Brief description of the content of the course:
   Students completing this course will be able to demonstrate an understanding of technical fundamentals of different mechanical biomedical equipment. Students will also demonstrate an ability to recognize and define the functions, principles of operation, components, and required maintenance procedures of different types of mechanical biomedical equipment including artificial kidney (hemodialysis machines), water treatment systems, artificial respiration systems (ventilators), medical gas systems, and sterilization systems.

   b. Prerequisites or co-requisites:
   Pre-requisites: BMT 232 / Mechanical Medical Equipment I
   Co-requisites: None

   c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

   a. Specific outcomes of instruction:

   This course is intended to provide basic knowledge and understanding of technical fundamentals of different mechanical biomedical equipment. The student should develop the ability to recognize and define the functions, principles of operation, components, and required maintenance procedures of different types of mechanical biomedical equipment. Moreover, students should

demonstrate the ability to identify and use appropriate technical literature and apply oral and written communication skills by submitting specific presentations and reports.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | ABET (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of technical fundamentals of different mechanical biomedical equipment. | a |
| 2 | Students will demonstrate an ability to recognize and define functions, principles of operation, components of different types of mechanical biomedical equipment. | a |
| 3 | Students will demonstrate an understanding of required maintenance procedures of different types of mechanical biomedical equipment. | a |
| 4 | All topics are targeted in practical sessions in laboratory. | c |
| 5 | students will demonstrate an ability to identify and use appropriate technical literature and apply oral and written communication skills by submitting specific presentations and reports. | g |

c. Brief list of topics to be covered:

| Topics |
|---|
| Fundamentals of medical instrumentation |
| Water treatment for hemodialysis machine |
| Hemodialysis machine (design and mechanism) |
| Asepsis: Sterilization and disinfection (different commonly used techniques in the field as well as new techniques in the literature) |
| Hospital gas system (system of supplying of oxygen, compressed air, vacuum, and anesthetic gases) |
| Coronary Stents |
| SFDA Regulation for Medical Equipment |
| Ventilation system (situations in which ventilation is required and techniques of providing ventilation to patients) |

d. Schedule of Assessment Tasks for Students During the Semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Home Works | Throughout Semester | 5% |
| b. | Class Exercises and Activities | Throughout Semester | 5% |
| c. | Quizzes | Throughout Semester | 5% |
| d. | Midterm Exam | 8 | 10% |
| e. | Lecture Presentation | Throughout Semester | 5% |
| f. | Project (Report and Presentation) | 13 & 14 | 10% |
| g. | Practical Reports and Exam | 13 | 20% |
| h. | Final exam | Final Exam Schedule | 40% |

# Course Syllabus
# BMT 336
# Optical Biomedical Instrumentation

1. Course number and name: BMT 336/ Optical Biomedical Instrumentation
2. Credits and contact hours: (2 + 1) credit hours, (2 +2) contact hours
3. Instructor's name: Dr. Adham Aleid
4. Text book, title, author, and year:
   - Books or notes: ""Introduction to Optics", Frank L.
   - other supplemental materials:
     - Introduction to Optics (Advanced Texts in Physics), Germain Chartier
     - Lecture notes (available on my website and LMS system)
5. Specific course information
   a. brief description of the content of the course:
      This course covers the major optical devices used in biomedical field in terms of their principles of operation, their main component and the underlying relevant optical phenomena. Students also in this course are exposed to advanced optical techniques and their biomedical applications.
   b. prerequisites or co-requisites:
      Pre-requisites: BMT 224
      Co-requisites: NA
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required
6. Specific goals for the course
   a. specific outcomes of instruction:

- Understand the basic principles of optical instrumentation and technology used in this field
- Understand the basic physical principles and relevant optical phenomena, required to understand the operation of optical instrumentation in biomedical field.

- Recognize and understand the major components of optical instrumentation systems.
- Develop an ability to use the, fiber optics, light sources and detectors in biomedical field.
- Understand the operation of advanced optical techniques such as electronic microscopy and fluorescence.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Ability to use the knowledge of physics and mathematics to understand the optical phenomena and the underlying physical principles relevant to biomedical optical instrumentation. | b |
| 2 | An ability to properly using equipment needed to conduct standard tests and measurements to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes. | c |
| 3 | Expose students to a wide range of clinical applications of optical-based instruments, and potential uses of optical techniques in the biomedical field. | j |

c. Brief list of topics to be covered

| Topics |
|---|
| Electromagnetic waves & nature of light. |
| Reflection (mirrors) |
| Refraction |
| Lenses |
| Prism & Diffraction |
| Human eye & camera |
| Simple magnifier & light microscope |
| Optical detectors |
| Laser |
| fiber optic |
| Electron microscopy |
| Spectrophotometry |
| Electromagnetic waves & nature of light. |

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Midterm 1 | 6 | 16% |
| b. | Short Exam | 11 | 8% |
| c. | Special topic presentation | 13 | 8% |
| d. | Lecture Quizzes | Continues | 8% |
| e. | Lab report | Continues | 10% |
| f. | Lab exam | 14 | 10% |
| g. | Final exam | 16 | 40% |

# Course Syllabus
# BMT 337
# BIOMATERIALS

1. Course number and name: BMT 337/ BIOMATERIALS

2. Credits and contact hours: (2 + 0) credit hours, (2 +0) contact hours

3. Instructor's name: Dr. ALI S. ALANAZI

4. Text book, title, author, and year:

    - Books or notes: Biomaterials: An introduction
        - Joon Park R.S. Lakes
        - Third Edition: 2007 Springer Science.
    - other supplemental materials:

- Fundamentals of Materials Science and Engineering:
    - An Integrated Approach W.D. Callister, Jr. and D. G. Rethwisch 8th Edition: John Wiley and Sons, Inc. (2010).
- Lecture notes (available on my website and LMS system)
- Website of text book publisher (http:// www.journals.elsevier.com/biomaterials/)

5. Specific course information

    a. Brief description of the content of the course:
    The purpose of this course is to present an overview of fundamental biomaterials. Topics include; Definition of biomaterials, Characterization of materials, Metallic implant, Ceramics implants, Polymers implants, Tissue response, and Biocompatibility.

    b. prerequisites or co-requisites:
    Pre-requisites: BMT2
    Co-requisites: NA

    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

    a. specific outcomes of instruction:

- To study and define the knowledge, properties, classifications, and modern smart applications of biomaterials science and engineering.;
- To study and define a knowledge of materials properties, materials classifications and biomaterials selection and design,
- To study the introduction of biocompatibility tests and regulations, tissue response to implants and biomaterials processing;
- To study and solve broadly-defined biomaterials engineering and technology problems.;
- To study and demonstrate the ability to apply written, oral, graphical communication effectively

    b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Considered ABET outcomes:

- Ability to select and define the knowledge, techniques, skills, and modern tools of biomaterials science and engineering.;

- Ability to select and define a knowledge of materials properties, materials classifications and biomaterials selection and design, biocompatibility tests and regulations, tissue response to implants and biomaterials processing ;

- Ability to identify, analyze, and solve broadly-defined biomaterials engineering and technology problems.;

- Demonstrate the ability to apply written, oral, graphical communication effectively

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of basic materials science and engineering characterization and properties. | b |
| 2 | Students will demonstrate an understanding of biomaterials classifications and materials selection for specific applications. | b, f |
| 3 | Student will demonstrate a basic understanding of the application of the biomaterials and its regulations. | b, f |
| 4 | Students will be able to conduct standard tests and regulation; to conduct, biocompatibility test types for biomaterials. | c |

c. Brief list of topics to be covered

| Topics |
| --- |
| Definition of Biomaterials |
| Characterization of Materials, |
| Plates for fixing fractures |
| Metallic Implant Materials |
| Ceramic Implant Materials |
| Polymeric Implant Materials |
| Composites as Biomaterials |
| Structure–Property Relationships of Biological Materials |
| Tissue Response to Implants |
| Biocompatibility |

# Course Syllabus
# BMT 338
# Introduction to Biomedical Engineering Design

1. Course number and name: BMT 338 / Introduction to Biomedical Engineering Design

2. Credits and contact hours: (2 + 0) credit hours, (2 + 0) contact hours

3. Instructor's name: Dr. Wissal Mesfar

4. Text book, title, author, and year:

   a. Books or notes:

- Mechanics of Materials, 6th Edition, James M. Gere, 2004
- Mechanics of Biomaterials - Fundamental Principles for Implant Design, Lisa Pruitt Cambridge University Press, 2012.
- Lecture notes Syllabus of Lab (available on LMS system)

   b. Other supplemental materials:

5. Specific course information

   a. Brief description of the content of the course:

At the beginning, this course provides students with knowledge in mechanics of material including determination of the different stress and strain relationships to solve mechanical structure under various applied loading type such as axial loading, torsion loading and bending loading. The course provides as well methods to draw the shear force and bending moment diagrams. In the second part and based on the knowledge of the previous chapters, the course provides an application on the design of a hip implant to reduce the stress shielding in the femoral bone after a total hip replacement. Determination of stress of a composite structure made of metal and bone will be provided. The bone remodeling phenomenon will be considered to optimize the design of hip stem geometry by determining the best geometrical and material properties parameters to reduce the stress shielding.

   b. Prerequisites or co-requisites:

Pre-requisites: BMT 232

Co-requisites: None

c. Indicate whether this course is a required, elective, or selected elective (as per Table 5-1) course in the program:
Required

6. Specific goals for the course

a. Specific outcomes of instruction:

By the end of this course, the student should be able to demonstrate the ability:
- to use the mechanics of material theory to solve problems related to mechanical structures under various type of loading.
- to use the mechanics of material theory to design mechanical structures including mechanical biomedical devices, artificial human joints, and biomedical implants.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Ability to select mechanics of material to solve problem and analyze mechanical structures under various type of loading. | b, f |
| 2 | Ability to use the mechanics of material theory to design mechanical structures including mechanical biomedical devices, artificial human joints, etc. | b, d |

c. Brief list of topics to be covered

| Topics |
|---|
| Introduction of the course, review of statics |
| Axial Loading (Tension and Compression): Stress-strain curves, superposition method, compatibility equations, truss structures resolution, thermal stress. |
| Torsion Loading: Relationship between torque loading and the induced stress, strain, and twisting angle, transmission of Power by Circular Shafts. |
| Shear force and bending moment diagrams: Internal forces in beams, relationships between loads, shear forces, and bending moments and drawing of the shear force and bending moments diagrams. |

| |
|---|
| Bending Moment Loading: Centroid of plane and composite areas, moments of inertia, parallel-axis theorem, pure and nonuniform bending, longitudinal strains, normal stresses, design of beams for bending stresses, shear stresses of rectangular cross section, shear stresses in the webs of beams with flanges, built-up beams and shear flow. |
| Optimization of the design of the stem of hip prosthesis to reduce stress shielding in the femoral bone. Stress and strain in composite beam (made of idealized bone and biocompatible material), material and geometry optimization to reduce bone absorption. |

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | At the end of each chapter, one assignment (two assignments for chap 2) should be done and submitted per due date (7 assignments in total). | One week after the end of the chapter | All the assignment accounts for 30% |
| b. | 1 Mid term | Week 8-9 | 30% |
| c. | Final Exam | Please refer the Final exam schedule | 40% |

# Course Syllabus
# BMT 367
# Hospital Safety

1. Course number and name: BMT 367/ Hospital Safety

2. Credits and contact hours: (1 + 1) credit hours, (1 +2) contact hours

3. Instructor's name: Abdullah BenOmran

4. Text book, title, author, and year:

    a. Books or notes:

    b. Medical Instrumentation: Application and Design, John G. Webster.
    c. An Introduction to Radiation Protection, Alan Martin, Sam Harbison.

    d. Other supplemental materials:

    e. Lecture notes available on LMS system

5. Specific course information

    a. brief description of the content of the course:

        This course covers safety issues within healthcare facilities. It mainly focuses on electrical safety for medical devices. This is covered on the level of medical device design and on the level of power distribution system. Other safety issues such as radiation protection and medical waste management are covered as well. In the practical, students are trained to use the electrical safety analyzer to perform safety tests such as leakage current, ground resistance, insulation resistance, patient leakage current ...etc.
    b. prerequisites or co-requisites:

    Pre-requisites: BMT 211
    Co-requisites: NA
    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

    a. specific outcomes of instruction:

        Upon completing BMT367, students should have the following capabilities:

Understand the effect and danger of electricity on human body and understand methods of protection from electrical shock.
Understand effects of ionizing radiation on human body and understand methods of protection from radiation.
Understand the dangerous of medical wastes and understand methods for treating medical wastes.
Use safety analyzer to perform electrical safety tests.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Ability to use the knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to recognize common hazards in hospitals and the effects of these hazards on human body and to understand the principles of measuring these hazards. | b |
| 2 | Ability to perform safety tests for medical equipment using the safety analyzer, including leakage current, ground resistance, insulation resistance, case leakage current .. etc. | c |
| 3 | a knowledge of the hazards present in hospital environment including electrical, radiation, and waste hazards and how to deal with these hazards in order to contain or eliminate them. | j |
| | Using the learning management system | k |

c. Brief list of topics to be covered

| Topics |
|---|
| Introduction of the course, review of basic circuit laws: ohm law, parallel and series resistance, current divider law, and voltage divider law. |
| Electrical Safety: Tissue response to electrical current, Electrical shock, Leakage current and leakage current limitation, Different human body impedance, Protection: Power distribution, Equipment design, Grounding system, Isolated patient connections, Isolated power-Distribution system, Ground-Fault circuit Interrupters (GFCI) |
| Radiation safety: Ionizing and non-ionizing radiation, Effects caused by different doses of radiation on humans, Major sources of radiation exposure, Dose limits |

| |
|---|
| Medical waste: Infectious waste, Hazardous waste, Radioactive waste, Waste collection, Disposal technology, Incineration, Autoclaves, Mechanical/Chemical Disinfection, Microwaving<br>Irradiation |
| Special topics related to safety: Micro-biological contamination control in hospitals, Needlesticks, Electrocautery Smoke, Safe use of Ethylene Oxide in Hospitals, Monitoring Aldehydes, Trace Anesthetic Gas, Respiratory protection in Hospitals |

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | **First Midterm** | 7 | 15% |
| b. | **Second Midterm** | 10 | 10% |
| c. | **Quizzes, LMS, In-class participation** | | 5% |
| d. | **Practical** | | 30% |
| e. | **Final** | | 40% |

# Course Syllabus
# BMT 413
# BIOMEDICAL ELECTRONICS IV

1. Course number and name: BMT 413/ BIOMEDICAL ELECTRONICS IV

2. Credits and contact hours: (2 + 1) credit hours, (2 +2) contact hours

3. Instructor's name: Dr. Ali S Al-Mejrad

4. Text book, title, author, and year:

- Books or notes:
- Selected Notes consist of three parts
- other supplemental materials:
- Digital Systems: Principles & Applications by Ronald J. Tocci (12th Edition), 2017, Pearson Education
- Microprocessor based System, Douglas Boniface, Horwood Publishing

5. Specific course information

a. brief description of the content of the course:

Upon completing this course, students should have the following capabilities:

- Knowledge of the construction and operation of microprocessor and microcontroller.
- Knowledge of assembly programming of microprocessor and microcontroller.
- Knowledge of designing interface circuits of memory and I/O devices with microprocessor and microcontroller.
- Ability to write assembly language and high level programs to conduct experiments using microprocessor and microcontroller kits.
- Knowledge of applications of microprocessors and microcontroller in biomedical instrumentation.

b. prerequisites or co-requisites:

Pre-requisites: BMT314

Co-requisites: NA

c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

    a. specific outcomes of instruction:

        - an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical technology to include the application of circuit analysis, analog and digital electronics, microcomputers, biomechanics, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment.
        - Students select and apply the knowledge, techniques, and skills of digital electronics to advanced digital systems using microprocessor and microcontroller related activities

        - an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of biomedical systems.
        - Students select and apply knowledge of mathematics, science, engineering, and technology to microprocessor and microcontroller based system problems

        - An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.
        - Students conduct standard tests and measurements; conduct, analyze, and interpret experiments using advanced digital system using microprocessor and microcontroller.

        - an ability to analyze, design, and implement biomedical systems, components or processes for broadly-defined engineering technology problems appropriate to program educational objectives.
        - Students design advanced digital system using microprocessor and microcontroller devices.

    b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

    Considered ABET outcomes:

    - an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical technology to include the application of circuit analysis, analog and digital electronics, microcomputers,

biomechanics, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment.

- an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of biomedical systems.

- an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.

- an ability to analyze, design, and implement biomedical systems, components or processes for broadly-defined engineering technology problems appropriate to program educational objectives.

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | Students select and apply the knowledge, techniques, and skills of digital electronics to advanced digital systems using microprocessor and microcontroller related activities | a |
| 2 | Students select and apply knowledge of mathematics, science, engineering, and technology to microprocessor and microcontroller based system problems | b |
| 3 | Students conduct standard tests and measurements; conduct, analyze, and interpret experiments using advanced digital system using microprocessor and microcontroller. | c |
| 4 | Students design advanced digital system using microprocessor and microcontroller devices. | d |

c. Brief list of topics to be covered

| Topics |
|---|
| 1-Review of digital principles |
| 2-Introduction to general processor based system with definitions to the different units and buses |
| 3-Organization and internal structure of the microprocessor |
| 4-Operation of the microprocessor |
| 5-Memory: types, size and organization; Input/Output ( I/O) devices |
| 6-Address decoding for memory and I/O |
| 7-Introduction to programming techniques: program development, program design and program running |
| 8-Introduction to assembly programming: basic definitions, instruction definition & categories and addressing modes |
| 9-Assembly programming: data transfer, data processing, |
| 10-Assembly programming: flow control, I/O and other microprocessor control |
| 11-12-Software applications |
| 13-Applications on the use of microprocessor in Biomedical Instrumentation with discussion of microprocessor based Biomedical Instrumentation faults |

# Course Syllabus
# BMT414
# Biomedical Electronics 6

1. Course number and name: BMT 414 / Biomedical Electronics 6

2. Credits and contact hours: 3 credit hours

3. Instructor's name: Eng. Mohammad Shaban, Dr. Ali Saad

4. Text book, title, author, and year:

   - Books or notes: Medical instrumentation Application and design, third edition, John Webster, John Wiley &Sons, 2007.

5. Specific course information

   a. brief description of the content of the course:

This course terminates the coverage of the electronic courses, it is an application to medical instrumentation mainly electronic instruments. It covers the main medical instruments used in hospital, like defibrillators, pacemakers, electrical surgery instruments. It describes also method for ablation and instruments used for it. MRI principles and instrument design and analysis are described. EEG, EMG and Catheterization & Cardiac Output are also taught. http://faculty.ksu.edu.sa/alisaad/Pages/BMT414.aspx

   b. prerequisites or co-requisites: BMT 313 biomedical electronics (3)

      Co-requisites: NA

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

   a. specific outcomes of instruction:

Course Learning Outcomes:
Upon completing BMT414, students should have the following capabilities:

- Study a large group of electronic medical instruments existing at the hospital. (ABET Outcome b)
- Develop an ability to design and analyze medical instruments. (ABET Outcome d)
- To be able to conduct standard tests and measurements; to conduct, and interpret experiments; and to apply experimental results to improve processes. (ABET Outcome c)
- Ability to communicate by reading, understanding and prepare a report and presentation of a published research paper. (ABET Outcome g)

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Student Outcomes Covered by Course:

1. an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of biomedical instrumentation systems.

2. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.

3. an ability to design biomedical instrumentation systems, components or processes for broadly defined engineering technology problems appropriate to program educational objectives.

4. an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature.

c. Brief list of topics to be covered

1. Defibrillators
2. Cardioversion
3. Pacemakers
4. Electrosurgery instruments
5. Ablation methods and instruments
6. Medical L-A-S-E-R instruments
7. EEG Brain signal measurement and analysis
8. EMG muscle signal measurement methods
9. Catheterization & Cardiac Output
10. Magnetic Resonance Imaging (MRI)

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Midterm1- essay | 6 | 15% |
| b. | Midterm2- essay | 12 | 15% |
| c. | Practical exam + reports | 13 | 20% |
| d. | Project (research paper): oral presentation | 14 | 5% |
| e. | Final exam | 16 | 40% |
| f. | Quiz | Cont. | 2% |
| g. | Homework | Cont. | 3% |

# Course Syllabus
# BMT415
# Digital Signal Processing

1. Course number and name: BMT 415 / Digital Signal Processing
2. Credits and contact hours: 3 credit hours
3. Instructor's name: Mr. Amr Rodwan, Dr. Ali Saad
4. Text book, title, author, and year:
    a. Books or notes: Primary: Analog and Digital signal processing, second edition, Ashok Ambardar, Brooks/Cole publishing company, 1999.
5. Specific course information
    a. Course Description (catalog): This course continues the coverage of the fundamental concepts of Discrete Signals, Sampling and Quantization, Discrete Convolution, the Z transform, application of Z transform, Fourier transform and application on system analysis, Digital filters-IIR, FIR. LMS all documents are included.

b. Prerequisites: None

Co-requisite: None

c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course
    a. specific outcomes of instruction:

Course Learning Outcomes:
Upon completing BMT415, students should have the following capabilities:

- Understand basics of digital signal processing.
- Application of digital signal processing to biomedical signals
- Develop an ability to design and analyze signal processing systems.

    b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

1. Student Outcomes Covered by Course:

2. an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical instrumentation to include the application of circuit analysis and design, analog and digital electronics, microcomputers, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment.
3. Understanding sampling and reconstruction in both the time and frequency domains, understanding linear time-invariant systems, system properties, the convolution sum, and properties of convolution.

    a. an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of biomedical instrumentation systems.

4. The ability to understand the Z-transform and its application to identifying system properties, solving difference equations, and determining the frequency response of a system and to understand system analysis using Fourier Transform.

    a. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.

5. Students are requested to design small systems and implement and test their solutions in HW and Lab assignments.

    a. an ability to design biomedical instrumentation systems, components or processes for broadly defined engineering technology problems appropriate to program educational objectives.

    b. an ability to function effectively as a member or leader on a technical team.

    c. an ability to identify, analyze, solve and implement biomedical instrumentation systems.

    d. an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature.

e. an understanding of the need for and an ability to engage in self-directed continuing professional development.

f. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.

g. a knowledge of the impact of engineering technology solutions in a societal and global context and an understanding of the clinical application of biomedical equipment.

h. a commitment to quality, timeliness, and continuous improvement.

c. Brief list of topics to be covered

1. Discrete Signals
2. Sampling and Quantization
3. Discrete Convolution
4. the Z transform
5. application of Z transform
6. Fourier transform and application on system analysis
7. Digital filters

d.Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Written exam 1 | 6 | 15% |
| b. | Written exam 2 | 12 | 15% |
| c. | Homework | Cont. | 5% |
| d. | Quiz | Cont. | 5% |
| e. | Practical exam | 12 | 20% |
| f. | Final written exam | 16 | 40% |

# Course Syllabus
# BMT 437
# BIOMEDICAL CONTROL

1. Course number and name: BMT 437/ BIOMEDICAL CONTROL SYSTEMS
2. Credits and contact hours: (2 + 0) credit hours, (2 +0) contact hours
3. Instructor's name: Dr. Magdy Gamal Elghatwary
4. Text book, title, author, and year:
    a. Books or notes: Katsuhijo Ogata, "Modern Control Engineering", 5th edition, Printice Hall, 2013
    - other supplemental materials:
        - Lecture notes (available on my website and LMS system)
        - Website of text book publisher
5. Specific course information

a. brief description of the content of the course:
Students completing this course will be able to analyze the basic components of control systems, the concepts of feedback, closed-loop control versus open-loop control using the Laplace transform to solve linear differential equation, finding transfer function for linear time-invariant electrical and mechanical understanding the concepts of poles and zeros and how to find time response from transfer function and determine the stability of a system.

b. prerequisites or co-requisites:
Pre-requisites: NA
Co-requisites: NA

c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

a. specific outcomes of instruction:
This course is intended to provide basic knowledge and understanding of the fundamentals of Automatic control. The student should develop the ability to study system stability. and develop the ability to be able to choose between various approaches. The students should extend their problem-solving abilities.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | abet (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding the fundamental basic control system, the concept of feedback, closed-loop control versus open-loop, examples of control systems, transfer function, types of feedback control system characteristics-noise rejection, gain, sensitivity, stability | a |
| 2 | Students demonstrate an ability to understand the concept of poles and zeros, to find the time response from a transfer function, to analyze stability of the system. The ability to understand the Laplace transforms to solve linear differential equations, finding transfer function for linear time invariant electrical and mechanical. | b |
| 3 | Students are required to design small systems and implement and test their solutions in HW | c |

c. Brief list of topics to be covered

| Topics |
|---|
| Introduction to control engineering |
| Models of physical systems |
| State variable models, system response |
| Control system characteristics |
| Stability analysis, root-locus analysis and design |
| Frequency response design |
| Biological control systems |

d. Schedule of Assessment Tasks for Students During the semester

| Schedule of Assessment Tasks for Students During the Semester | | | |
|---|---|---|---|
| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
| 1 | Participation | Continuous | 5% |
| 2 | Midterm1 | 7 | 20% |
| 3 | Midterm2 | 12 | 20% |
| 4 | Presentation | 14 | 15% |
| 5 | Final exam | Final Exams Period | 40% |

# Course Syllabus
# BMT 484
# Automation in Clinical Laboratory

1. Course number and name: BMT 484 / Automation in Clinical Laboratory

2. Credits and contact hours: 3 (2 + 1) credit hours, 4 (2 +2) contact hours

3. Instructor's name: Dr. Mohammed Fayez Al Rez

4. Text book, title, author, and year:

   a. Books or notes: John G. Webster, "Medical Instrumentation Application and Design", 4th edition, 2010, Wiley.

   b. Other supplemental materials:
   - Lecture notes and power point slides (available on LMS website)

5. Specific course information

   a. Brief description of the content of the course:
   Students completing this course will be able to demonstrate an understanding of fundamentals of automation in clinical laboratory and techniques of different medical laboratory equipment used for testing blood and metabolic waste products. Students will also demonstrate an ability to recognize and define the purposes, principles of operation, components, and required calibration procedures and maintenance of different types of laboratory equipment including colorimeters, laboratory centrifuge machine, blood glucose monitors, blood gas analyzer, pH-meter, blood cell counter, autoanalyzer and chromatography.

   b. Prerequisites or co-requisites:
   Pre-requisites: BMT 315 / Introduction to Bioelectrical Instrumentation
   Co-requisites: None

   c. Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

   a. Specific outcomes of instruction:

   This course is intended to provide basic knowledge and understanding of fundamentals of automation in clinical laboratory and techniques of different medical equipment used in laboratory for blood and metabolic waste products testing. The student should develop the ability to recognize and define the purpose, principles of operation, components, and required calibration procedures and maintenance of different types of laboratory equipment.

Moreover, students should demonstrate the ability to identify and use appropriate technical literature and apply oral and written communication skills by submitting specific presentations and reports.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | ABET (a-k) |
|---|---|---|
| 1 | Students will demonstrate an understanding of fundamentals of automation in clinical laboratory. | a |
| 2 | Students will demonstrate an ability to recognize and define different techniques of laboratory equipment used for testing blood and metabolic waste products and their medical purposes. | a |
| 3 | Students will demonstrate an ability to recognize and define principles of operation, components of different types of laboratory equipment. | a, b |
| 4 | Students will demonstrate an understanding of required calibration procedures and maintenance of different types of laboratory equipment. | a, b |
| 5 | All topics are targeted in practical sessions in laboratory. | c |
| 6 | students will demonstrate an ability to identify and use appropriate technical literature and apply oral and written communication skills by submitting specific presentations and reports. | g |

c. Brief list of topics to be covered:

| Topics |
|---|
| Fundamentals of Automation in Clinical Laboratory |
| Blood and its Components |
| Blood Glucose Monitor |
| Laboratory Centrifuge |
| Colorimeter |
| Blood Gas Analyzer |
| pH-Meter |
| Blood Cells Counter |
| Autoanalyzer |
| Chromatography |

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | Home Works | Throughout Semester | 5% |
| b. | Class Exercises and Activities | Throughout Semester | 5% |
| c. | Quizzes | Throughout Semester | 5% |
| d. | Midterm Exam | 8 | 10% |
| e. | Lecture Presentation | Throughout Semester | 5% |
| f. | Project (Report and Presentation) | 13 & 14 | 10% |
| g. | Practical Reports and Exam | 13 | 20% |
| h. | Final exam | Final Exam Schedule | 40% |

# Course Syllabus
# BMT 485
# Biomedical Computing

1. Course number and name: BMT 485/ Biomedical Computing

2. Credits and contact hours: (3 + 1) credit hours, (3 +2) contact hours

3. Instructor's name: Prof. Nabil A. Alrajeh

4. Text book, title, author, and year:

   - Books or notes: Biomedical Informatics: Computer Applications in Health Care and Biomedicine. By Edward H. Shortliffe (Editor), James J. Cimino (Editor). ISBN-13: 978-1447144731 ISBN-10: 1447144732 Edition: 4th ed. 2014 , Springer-Verlag

   Other supplemental materials:

   - Title: Health Information Systems: Concepts, Methodologies, Tools, and Applications
     Author(s)/Editor(s): Joel J.P.C. Rodrigues
     ISBN13: 9781605669885; EISBN13: 9781605669892
     URL: www.igi-global.com/book/health-information-systems/37245

5. Specific course information

   - brief description of the content of the course:
     Biomedical computing course provides students a conceptual framework for understanding Health Informatics and applications of information technology in the healthcare environment. The course will include in-depth discussion of how to use of technology in health care systems with emphasis on leveraging technology to improve quality and efficiency in care delivery. Moreover, the course provides an overview of the most important aspects of health informatics that will impact the clinical research, education, health management and clinical services.
   - prerequisites or co-requisites:
     Pre-requisites: BMT413
     Co-requisites: NA

   - indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

a. specific outcomes of instruction:

- Explain biomedical computing and its role in health, health care, public health, medical education and biomedical research.
- Compare and contrast the roles of various individuals in the health information technology workforce.
- Define the major challenges to health information technology adoption in health care organizations
- Describe and compare the best practice approaches to systems acquisition and system design.
- Identity the essential functions of the electronic health record (EHR) and the barriers to its use.
- Identify the components of the software development life cycle applied to health care
- Explain the process of computerized provider order entry and challenges to its use.
- Differentiate the difference among privacy, confidentiality, and security and their role in the HIPAA regulations.
- Explain the importance of standards and interoperability of clinical data and the major initiatives underway to create and enable them.
- Describe the management of images in clinical settings, including the use of PACS systems.
- Classify the different types of telehealth and their efficacy as shown in clinical studies.
- Explain how people and organizational issues impact the use of health information technology and criteria for selecting the proper hospital information systems.
- Explain the process of using Information technology in Patient monitoring to improve the health quality.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| | Course outcome | Abet (a-k) |
|---|---|---|
| 1 | This course is designed to introduce the fundamental principles of medical informatics. It is taught so that individuals with various backgrounds, including those with medical, computer science, or other backgrounds, can become familiar with information management and computer applications in health care. Students select and apply knowledge of mathematics, science, engineering, and technology to health information problems | b |
| 2 | an ability to analyze, design, and implement biomedical systems, components or processes for broadly-defined engineering | d |

| | | |
|---|---|---|
| | technology problems appropriate to program educational objectives. | |
| 3 | an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature. | g |
| 4 | a knowledge of the impact of engineering technology solutions in a societal and global context and an understanding of the clinical application of biomedical equipment. | j |

c. Brief list of topics to be covered

| Topics |
|---|
| 1. Biomedical Informatics: The Science and the Pragmatics |
| 2. Biomedical data : their acquisition, storage, and use. |
| 3. Computer Architectures for Health Care and Biomedicine |
| 4. Electronic Health Record Systems |
| 5. Computer In Healthcare Education |
| 6. Telehealth |
| 7. Software Engineering for Healthcare and Biomedicine |
| 8. Imaging systems 1 |
| 9. Imaging systems 2 (PACS) |
| 10. Patient-monitoring system |
| 11. Standards in Health Informatics |
| 12. Criteria for Selecting Health Information Systems |
| 13. Future uses of Health Informatics and important Concepts |

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.) | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| a. | 1 midterm test | 7th | 20% |
| b. | Assignments | weekly | 5% |
| c. | Project | 13th | 15% |
| d. | Practical | Weekly | 20% |
| e. | Final | 15th | 40% |

# Course Syllabus
# BMT 468
# Clinical Practice/Project

1. Course number and name: BMT 468/ Clinical Practice/Project
2. Credits and contact hours: (0 + 3) credit hours, (0 +6) contact hours
3. Instructor's name: project supervisor
4. Text book, title, author, and year:

- Essential References

- Joseph D. Bronzino and Donald R. Peterson, The Biomedical Engineering Handbook, CRC Press, 2015
- Jerry L. Prince, Jonathan M. Links, "Medical Imaging – Signals and Systems", 2 nd edition, 2015, Pearson
- R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw Hill Education (India) Private Limited; 3rd Revised edition edition (September 14, 2014)

John G. Webster and Halit Eren, Measurement, Instrumentation, and Sensors Handbook CRC Press; 2 edition (February 3, 2014)

- Recommended Journals

- Journal of Biomedical Engineering
- Journal of Biomedical Nanotechnology
- Journal of Biomedical Optics
- Journal of Biomedical Research
- Journal of Biomedical Materials Research
- Journal of Biomedical Science and Engineering
- International Journal of Biomedical Engineering and Technology

- Electronic Materials and Web Sites

- King Saud University Backboard
- http://www.ecri.org, HEALTHCARE PRODUCT COMPARISON SYSTEM
- Websites relevant to topics of the course

5. Specific course information

   a. brief description of course process:

      Each Students' group (2 students per group) discusses the project subject with its supervisor. Following the theoretical explanation by the supervisor, students group identifies and analyzes the problem, performs literature review, defines the methodological solution, applies the solution to the problem, gets and discusses the theoretical results, and defines the technical specifications and engineering standards of all required components, and then implements and tests the project. After that students group acquires results and writes the project report..

b. prerequisites or co-requisites:
   Pre-requisites: BMT 413, BMT 415, BMT 432, BMT 437, BMT 484
   Co-requisites: None
c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program: Required

6. Specific goals for the course

a. specific outcomes of instruction:. By the end of the course, students will be able to:

- Appreciate the relationship between various topics of biomedical technology
- Understand the role of biomedical technology in all health care sectors
- Apply gained skills to develop an biomedical systems using raw data and able to make decisions concerning impact on economics and society.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

| a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|
| X | X | X | X | X | X | X | X | X | X | X |

c. Brief list of topics to be covered

| Topics |
|---|
| Discussing and understanding the project subject given by supervisor |
| Theoretical explanation of the project subject |
| Literature review about the given project subject |
| Defining the methodological solution to the project and applying the solution |
| Defining of technical specifications and standards of all required components and systems needed for the implementation of project |
| Acquiring needed components and systems and project implementation |
| Testing the implemented project and acquiring results |
| Analysis, discussion and conclusion |
| Writing a report about the whole procedures done during the semester |

d. Schedule of Assessment Tasks for Students During the semester

| | Assessment task (e.g. essay, test, group project, examination, speech, | Week Due | Proportion of Total Assessment |
|---|---|---|---|
| 1 | Supervisor Evaluation | Throughout the | 40% |
| 2 | Final report Evaluation | Final Examination | 25% |
| 3 | Presentation Evaluation | Final Examination | 25% |
| 4 | Poster Evaluation | Final Examination | 10% |