ADAMAS UNIVERSITY

SCHOOL OF ENGINEERING & TECHNOLOGY

B.Tech. Biomedical Engineering

Course Structure

Academic Year 2024 - 25

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION OF THE UNIVERSITY

To be an internationally recognized university through excellence in inter-disciplinary education, research and innovation, preparing socially responsible well-grounded individuals contributing to nation building.

MISSION STATEMENTS OF THE UNIVERSITY

M.S 01: Improve employability through futuristic curriculum and progressive pedagogy with cutting-edge technology

M.S 02: Foster outcomes-based education system for continuous improvement in education, research and all allied activities

M.S 03: Install the notion of lifelong learning through culture of research and innovation

M.S 04: Collaborate with industries, research centers and professional bodies to stay relevant and up-to-date

M.S 05: Inculcate ethical principles and develop understanding of environmental and social realities

CHANCELLOR / VICE CHANCELLOR

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION OF THE SCHOOL

To develop well-grounded, socially responsible engineers and technocrats in a way to create a transformative impact on Indian society through continual innovation in education, research, creativity and entrepreneurship.

MISSION STATEMENTS OF THE SCHOOL

M.S 01: Build a transformative educational experience through disciplinary and inter-disciplinary knowledge, problem solving, communication and leadership skills.

M.S 02: Develop a collaborative environment open to the free exchange of ideas, where research, creativity, innovation and entrepreneurship can flourish among individual students.

M.S 03: Impact society in a transformative way – regionally and nationally - by engaging with partners outside the borders of the university campus.

M.S 04: Promote outreach programs which strives to inculcate ethical standards and good character in the minds of young professionals.

DEAN / SOET

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION OF THE DEPARTMENT

Provide holistic education and research environment for achieving excellence in the field of Biomedical Engineering research and development

MISSION STATEMENTS OF THE DEPARTMENT

M.S 01: Offer well-crafted interdisciplinary curriculum of Biomedical Engineering blended with futuristic and innovative pedagogy to provide strong foundation of knowledge and competent skills.

M.S 02: Impart skills and ethics for developing both professional and societal responsibilities.

M.S 03: Inculcate application-oriented skill sets conducting extensive training and research projects through multidisciplinary collaboration at both academia and industry level.

M.S 04: Foster design-thinking to create translatable solutions for human health and for development of health care technologies.

M.S 05: Nurture new ideas towards the self-reliance and entrepreneurship development.

HOD **DEAN/SOET**

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Name of the Programme: B.Tech. Biomedical Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO1: Biomedical engineering graduates will be able to apply knowledge and innovative ideas in the interdisciplinary domains ranging from engineering, instrumentation to material science in both professional and entrepreneur career.

PEO2: Biomedical engineering graduates will develop effective communication, decision making, problem solving and creative skills and will be able to apply in the development of both professional and entrepreneur career.

PEO3: Biomedical engineering graduates will practice the ethical responsibilities and safely guidelines wherever applicable.

HOD **DEAN / SCHOOL CONCERNED**

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Name of the Programme: B.Tech. BIOMEDICAL ENGINEERING

GRADUATE ATTRIBUTE / PROGRAMME OUTCOME (PO)

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.

PO2: **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning**: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

HOD **DEAN / SCHOOL CONCERNED**

ADAMAS UNIVERSITY, KOLKATA
SCHOOL OF ENGINEERING &TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Name of the Programme: B.Tech. BIOMEDICAL ENGINEERING
PROGRAMME SPECIFIC OUTCOME (PSO)

PSO1. Understand the basic concepts of all the sub-domains of Biomedical Engineering.

PSO2. Analyze the results and problems related to the health care sectors

PSO3. Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions

HOD CONCERNED **DEAN / SCHOOL**

Semester-I

MTH11501	**Engineering Mathematics-I**	L	T	P	C
Version 1.0	**Contact Hours – 60**	3	1	0	4
Pre-requisites/Exposure	12^{th} level Mathematics				
Co-requisites	--				

Course Objectives

1. To help the student to understand basic concept of abstract and vector algebra with its uses in engineering science.
2. To give emphasis about concepts of differential calculus and enable students to apply these topics in real life problems.
3. To give the students a perspective to learn integral calculus and it's importance in advanced study in engineering science.
4. To enable students, acquire fundamental concept of ordinary differential equation and it's applications in engineering science.

Course Outcomes

On completion of this course, the students will be able to

CO1	**Develop** the idea of basic concepts of abstract algebra and geometrical idea of vector analysis with real world applications.
CO2	**Find** the fundamental concepts of differential calculus and apply these topics in real life problems
CO3	**Find** the fundamental concepts of Integral Calculus and apply these topics in real life problems.
CO4	**Apply** the various solution procedures of Ordinary Differential equations in engineering problems.

Course Description

For engineering course, Mathematics is the backbone. Students will be having good engineering skills if their idea for Mathematics is clear. In this course the focus will be to learn Mathematics in depth which will motivate students to grow their thinking ability for Engineering also. By knowing the theory student will be able to apply that successfully to all kind of problems of Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities (Problem solving, presentation etc.).

Course Content

Unit I: Differential Calculus [20L]

Introduction to limit, continuity, derivative for function of one variable; Successive differentiation, Leibnitz's theorem; Rolle's theorem, Lagrange's mean value theorem, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms; Concavity and convexity of a curve, Points of inflexion, Maxima and Minima

Limit, continuity, and differentiability of a functions of several variables; partial derivatives and their geometrical interpretation; chain rule, total derivative, derivatives of composite and implicit functions; homogeneous function, Euler's theorem on homogeneous functions; Jacobian of variable

transformation; maxima and minima of functions of several variables, Lagrange's method of multipliers

Unit II: Integral Calculus [15L]

Review of definite integrals, Reduction formulae, Improper integral, Beta and Gamma functions, elementary properties, Rectification, double and triple integrals, computations of area, surfaces and volumes, change of variables in double integrals, applications

Unit III: Linear Algebra [18L]

Basics of real and complex matrices, Determinant and its properties, Orthogonal matrices, Hermitian and skew-Hermitian matrices, Unitary matrices, Elementary row and column operations on a matrix, Rank, echelon form, Inverse of a matrix using elementary operations, Solution of system of linear equations, Consistency, Characteristic equation, Caley-Hamillton theorem, eigenvalues and eigenvectors, algebraic and geometric multiplicity, diagonalization

Unit IV: Vector Algebra [7L]

Scalar and vector fields, Vector product, Scalar triple product and their interpretation, directional derivative, gradient, Curl, divergence

Text Book:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House

Reference Book:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications
2. G. B. Thomas Jr., M. D. Weir, J. R. Hass, Thomas Calculus Early Transcendentals, 12th Edition
3. James Stewart, Calculus: Concepts and Contexts, 4th Edition, Cengage Learning

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Develop** the idea of basic concepts of abstract algebra and geometrical idea of vector analysis with real world applications.	**PO2, PO3, PO4, PO12**
CO2	**Find** the fundamental concepts of differential calculus and apply these topics in real life problems	**PO2, PO3, PO4, PO12**
CO3	**Find** the fundamental concepts of Integral Calculus and apply these topics in real life problems.	**PO2, PO3, PO4, PO12**
CO4	**Apply** the various solution procedures of Ordinary Differential equations in engineering problems.	**PO2, PO3, PO4, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO 1	P O 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
MTH1150 1	Engineering Mathematics -I		3	3	3								3		

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

Name: **Enrolment No:**	

Course: MTH11501 – Engineering Mathematics-I
Program: B.Tech. (All Programs) **Semester: ODD 2020-21**
Time: 03 hrs. **Max. Marks:50**
Instructions:
Section A is compulsory (each carrying 5 marks); All questions from **Section B** (each carrying 10 marks)**, Any one from Section C** (carrying 15 marks)**.**

	Section A		
1.	**Find** the solution of the following differential equation after reducing it to a homogeneous differential equation	**R**	**CO4**
2.	**Solve** the following system of simultaneous linear differential equations:	**Ap**	**CO4**
3.	**Find** if	**R**	**CO2**
	SECTION B		
4.	(a) **Find** the dimension of a rectangular box of maximum capacity whose surface area is given when the box is open at the top. (a) **Show** that , where . (b) **Find** . (c) **Show** that , if where	**R**	**CO2**
5.	**Illustrate** the convergence of the following series: a) b) , if is convergent. c)	**U**	**CO1**
	SECTION C (Any ONE)		
6.	a) **Show** that , where are any three vectors. b) **Show** that , if and .	**R**	**CO1**
7.	**Apply** the method of variation of parameters to solve:	**Ap**	**CO4**

PHY11201	Applied Science	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objectives

1. To develop the capability of the students for understanding fundamental aspects of physics.
2. To give students theoretical background, the key prerequisite for performing laboratory experiments.
3. To build up the foundations for further studies in physics and engineering.
4. Learn to analyze and evaluate various thermodynamic cycles used for energy production - work and heat, within the natural limits of conversion
5. To impart the knowledge of measurement of the rate of a chemical reaction and to gain knowledge of electrochemical procedure

Course Outcomes

At the end of the course, the student will be able to:

CO1 **Illustrate** the basics of vector calculus, its application in mechanics, and different harmonic motions.

CO2 **Build** the knowledge of physical optics and related application.

CO3 **Develop** the basic concepts of electromagnetic theory and em wave.

CO4 **Apply** fundamental concepts of thermodynamics to engineering applications, estimate thermodynamic properties of substances in gas and liquid states, and determine thermodynamic feasibility and efficiency of various energy related processes.

CO5 **Determine** the rate law, effect of temperature on the rate of a chemical reaction and determine the activation energy and assess the role of a catalyst on the rate of a chemical reaction, calculate the cell potential for a nonstandard cell.

Course Description

Applied science is a discipline that is used to apply existing scientific knowledge to develop more practical applications, for example: technology or inventions. In applied science different aspects of Mathematical Physics is used to develop information to explain phenomena in the natural world. This information is then put to use for practical endeavors through a controlled Laboratory environment. Applied science is generally engineering, which develops technology, although there might be dialogue between basic science and applied science (research and development).In this course the focus will be on improving the logical learning moved into a physical environment. Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as group discussions, cooperative group solving problems, analysis of video scenes and debates. Class participation is a fundamental aspect of this course.

Basic knowledge in chemistry is essential for understanding various energy-work relationships. Student will be able to develop engine. They will be able to increase the efficiency of an engine. Student will understand the different processes in chemical and physical science and their feasibility. The basic knowledge of the molecular structure and their bonding will impart the knowledge of the

reactivity and the application of different molecules. The knowledge of electrochemistry will impart a deep sense in preparing different electrochemical cells and their applications. Students will be encouraged to develop new models. We will apply different methodologies to inspire our students combining traditional classes with modern techniques. They will also take part in different project work in fundamental as well as in practical fields.

Course Content

Module 1: Mechanics [10 lecture hours]

Basic ideas of Vector Calculus Potential energy function, Conservative and non-conservative forces. Conservation laws of energy & momentum. Central and non-central forces, Gravitation, Kepler's Laws, Angular Velocity and Torque, Moment of Inertia, SHM, Damped, Undamped and forced Oscillations (no derivations).

Module 2: Optics [5 lecture hours]

Principle of Superposition and Interference from parallel thin films, Single slit and Double slit diffraction, Diffraction grating, dispersive power of Grating, resolving power of prism and grating. production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Nicol prism, specific rotation.

Module 3: Electromagnetic Theory [10 lecture hours]

Gauss's Law in Electrostatics, Boundary Value problems, Dielectrics, Motion of Charged Particles in crossed electric & magnetic fields, Velocity Selector & Magnetic focussing, Gauss law, continuity equation, Biot-Savart Law and its applications, inconsistency in Ampere's Law, Maxwell's equations (differential and integral forms), Poynting vector, Poynting Theorem (Statement only).

Module 4: Thermodynamics [10 lecture hours]

Importance and scope, definition of system and surroundings: type of systems (isolated, closed and open); extensive and intensive properties; steady state versus equilibrium state; concept of thermal equilibrium and the zeroth law of thermodynamics; thermodynamic coordinates, state of a system, equation of state, state functions and path functions; concept of heat and work (IUPAC convention); first law of thermodynamics, internal energy (U) as a state function; enthalpy as a state function; energy conservation in the living organism; heat changes at constant volume and constant pressure; relation between C_p and C_v using ideal gas; Thermodynamics of Chemical Processes, Concept of entropy, 2^{nd} law of thermodynamics, Idea of Chemical potential, Equilibrium conditions for closed systems.

Module 5: Reaction Kinetics, Catalysis & Electrochemistry [10 lecture hours]

Rate laws, 1^{st}Order reaction & 2^{nd}order reaction, Arrhenius equation, Mechanism and Theories of reaction rates, kinetic and thermodynamic control of reaction; idea of rate determining step; steady-state approximation; Characteristics and types of Catalyst, Theories of Catalysis, Electrode potential, Redox reaction & Nernst Equation.

Text Books

1. Principles of Engineering Physics by S. P. Kuila, (Volume I) New Central Book Agency (P) Ltd.
2. Principles of Engineering Physics by S. P. Kuila, (Volume II) New Central Book Agency (P) Ltd.
3. Engineering Physics by Partha Pratim Das and Abhishek Chakraborty
4. Engineering Physics I by S. K. Bhattacharya and Soumen Pal
5. Engineering Physics II by S. K. Bhattacharya and Soumen Pal
6. Engineering Chemistry (Cambridge University Press-Ist Edition) –Shikha Agarwal
7. P. W. Atkins, Physical Chemistry, ELBS/Oxford, 10th Edition, 2014

Reference Books

1. Optics by Ajoy Ghatak, Mc-graw Hill
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education Limited
3. Engineering Chemistry (Pearson Ed.)- K. Sesha Maheswaramma and MridulaChugh
4. Physical Chemistry (Sarat Book House)- P. C. Rakshit

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Illustrate** the basics of vector calculus, its application in mechanics, and different harmonic motions.	**PO1, PO4**
CO2	**Build** the knowledge of physical optics and related application.	**PO1, PO4**
CO3	**Develop** the basic concepts of electromagnetic theory and em wave.	**PO1, PO5, PO6**
CO4	**Apply** fundamental concepts of thermodynamics to engineering applications, estimate thermodynamic properties of substances in gas and liquid states, and determine thermodynamic feasibility and efficiency of various energy related processes.	**PO1, PO2, PO4, PO5**
CO5	**Determine** the rate law, effect of temperature on the rate of a chemical reaction and determine the activation energy and assess the role of a catalyst on the rate of a chemical reaction, calculate the cell potential for a nonstandard cell.	**PO1, PO2, PO4, PO6**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas
PHY11201	Applied Science	3	2		3	2	2								

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech (All Program) Semester: I
PAPER TITLE: Applied Science PAPER CODE: PHY11201
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 14 Total No of Pages: 02

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (Answer All the Questions) (5 x 1 = 5)		
1.	**Define** polarization of light.	**R**	**CO 2**
2.	**State** Faraday's law of Electromagnetic induction.	**R**	**CO 3**
3.	**Define** Gauss's divergence theorem.	**R**	**CO 1**
4.	**Define** internal energy of a thermodynamics system	**R**	**CO 4**
5.	**State** Arrhenius relation between rate constant and temperature	**R**	**CO 5**
	SECTION B (Attempt any **Three Questions) (3 x 5 = 15)**		
6.	A cubical block of side L and density d is floating in a water of density $\rho(\rho>d)$. The block is slightly depressed and released. **Show that** it will execute simple harmonic motion and hence **determine** the frequency of oscillation.	**Ap**	**CO 1**
7.	**Show** that intensity distribution for diffraction in a single slit is given by, Where , a is the width of the slit, is the wavelength of light and is the angle of diffraction.	**U**	**CO 2**
8.	**Explain** Maxwell's modification on Ampere's law.	**Evaluate**	**CO 3**
9.	Show that . Hence find the value for an ideal gas. Comment on the value of (C_P-C_V) for a solid or a liquid.	**Ap**	**CO 4**

10	(a) When order and molecularity of reaction can be same? (b) Why does order can be fractional but molecularity cannot? (c) Write the units of rate constants for zero and second order reaction.	**U**	**CO 5**
	SECTION C (Answer Any Two Questions) (2 x 15 = 30)		
11.	(a) **Find** out the condition for maximum and minimum intensity in Young's Double slit experiment for Interference of Light. **Show** that Energy remains constant in this phenomena. [5+1] (b) In an interference experiment,'d' is the distance between the two coherent sources of light with wavelength λ and D is the distance between source to screen. **Show** that the separation between the two consecutive dark bands is given by β=λD/d. [4] (c) In Newton's Rings experiment the diameter of the 5th dark ring is 0.336 cm. and the diameter of the 15th dark ring is 0.590 cm. **Find** the radius of the plano-convex lens if the wavelength of the light used is 5890 A. [5]	**R** **U** **U** **R**	**CO 2**
12.	(a) **Derive** equation of continuity for current. **Show** that for steady current it reduces to =0. [5] (b) **Compare** the electrostatic force and Gravitational force between a proton and electron in a hydrogen atom. Given [5] (c) Five equal charges of 40 nC each are placed at five vertices of a regular hexagon of 6 cm side. The sixth vertex is free. **Determine** the electric field at the centre of the hexagon due to the distribution. [5]	**U** **U** **Evaluate**	**CO 3**
13.	(a) $dU=C_V\,dT$ Is this valid for all systems? State the conditions under which the equation is valid. [3] (b) Show that $PV^{\square}$= constant for an adiabatic process of a gas. State all the assumptions. [6] (c) I mole of an ideal gas is allowed to expand freely under adiabatic condition to double of its volume. The initial temperature of the gas is 300 K and the initial pressure is 1 atm. Find the final temperature, final pressure of the gas. Also calculate $\square U+\square H$ for the process. [6]	**U** **U** **Evaluate**	**CO -4**
14.	(a) What effect does temperature has on the rate of chemical reactions? Explain it on the basis of Arrhenius equation. [6] (b) Initial rate of a first order reaction increases three fold when temperature changes from 400 K to 420 K. If the half-life period of the reaction at 400 K is 10 min, calculate the time required for 20 % conversion of the reactant at 420 K and the activation energy**.** [6] (c) What is the significance of activation energy? [3]	**U** **Evaluate** **U**	**CO -5**

CSE11001	Introduction to Programming	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	10+2 Level Mathematics, Knowledge of Basics of Computer				
Co-requisites	Knowledge of Logical Reasoning and Analysis				

Course Objectives

1. To understand the nature of programming as human activity.
2. To practice the programming construct to solve multi-dimensional problems.
3. To relate and implement mathematical concepts through programming in order to solve computational problems.
4. To enable students to acquire structure and written expression required for their profession.
5. To understand the principles of data storage and manipulation.

Course Outcomes

On completion of this course, the students will be able to

CO1. Define basics concepts of programming structure and implement the basics concepts of Programming.

CO2. Solve and execute various problems using programming language and select the best solution.

CO3. Apply modularized solution and design such programs to appraise the solution

CO4. Illustrate the basic usage of memory and construct such memory in terms of array in a program. Students will also be able to define user defined data types using structure and Union. Create and manipulate permanent storage access through File Handling.

CO5. Define and construct different data structures for various collection of data.

Course Description

Programming skills are mandatory for designing or solving problems through digital device. It is the language through which computational/digital devices are communicated rather interfaced. To develop any software programming language is a must. In present era almost all aspect of life is somehow largely related to virtualization and digital data/information. Devices from smartphones to other handheld devices, drones, cameras, medical instruments etc. all needs programming at some part. In engineering it has become quintessential for the students/research scholars to learn programming. In this course, students will learn how to solve problems in various domains through a programming language. This course enables students with the basic skills of C Programming Language. Five Different related modules comprise this course. First Unit familiarizes students with basics of computers, algorithmic method to solve problem, introduction to generic programming construct. Basics of C Programming is upto iterative structure is depicted in Unit II. In Unit III students will learn about modularization using functions and one advance concept of C Programming, Pointers. Unit IV will cover one of the most important concepts in C Programming, Array and Strings. Unit V will accomplish this course with the advance concept like Structure, Union and File Handling. After this course students will grow their analytical ability to solve problem and logical skill. Also, this course effectively creates the ability to grasp any other Programming Language in easier manner.

Course Content

Unit I: 4 lecture hours

Basic Concepts of Programming: Introduction to components of a Computer System (disks, memory, processor, where a program is stored and executed, operating systems, compilers, etc.), Idea of Algorithm: steps to solve logical and numerical problems, Representation of Algorithms: Flowchart/Pseudo code with examples, From Algorithms to Programs; source code, variables and memory locations, Syntax and Logical Errors in compilation, Object and Executable code

Unit II: **10 lecture hours**

Basics of C Programming : Characters used in C, Identifiers, Keywords, Data type & sizes, Constants &Variables, Various Operators used such as Arithmetic Operators, Relational & Logical Operators, Increment & Decrement Operators, Assignment Operators, Conditional or Ternary Operators, Bitwise Operators & Expressions; Standard Input & Output, formatted input scanf( ), formatted output printf( ); Flow of Control, if-else, switch-case, Loop Control Statements, for loop, while loop, do-while loop, nested loop, break, continue, goto, label and exit( ) function

Unit III: **10 lecture hours**

Functions and Pointers: Definition of Function, Declaration or Prototype of Function, Various types of Functions, Call by Value, Call by Reference, Recursion, Tail Recursion, Definition of Pointer, Declaration of Pointer, Operators used in Pointer, Pointer Arithmetic, Functions with Pointer

Unit IV **17 lecture hours**

Arrays and String: Definition, Single and Multidimensional Arrays, Representation of Arrays - Row Major Order, and Column Major Order, Application of arrays – searching and sorting, Sparse Matrices and their representations. Definition of a String, Declaration of a String, Initialization of a String, Various String Handling Functions with example

Structures and Unions: Definition of a Structure, Declaration of a Structure & Structure Variable, Initialization of a Structure, Operators used in Structure, Structure within Structures, Union, Difference between a Structure and a Union

Files: Types of File, File Processing, Handling Characters, Handling Integers, Random File Accessing, Errors During File Processing

Unit V **4 lecture hours**

Overview of Stacks and Queues: Introduction to Stack, Primitive operations on Stack, Real-life applications of Stack, Introduction to Queues, Primitive operations on Queues, Real-life applications of Queues.

Text Books

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: mcgraw-hill.
2. Gotfreid (196) *Schaum's Outline of Programming with C*, 2 edn., USA: McGraw-Hill
3. Brian W. Kernighan, Dennis Ritchie (1988) *C Programming Language*, 2 edn., : Prentice Hall.

Reference Books

1. Al Kelley, Ira Pohl (1988) *A Book on C*, 4 edn., : Addision Wesley Longman**.**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Define** basics concepts of programming structure and implement the basics concepts of Programming.	**PO4, PO5**
CO2	**Solve** and execute various problems using programming language and select the best solution.	**PO1**
CO3	**Apply** modularized solution and design such programs to appraise the solution	**PO1, PO4**
CO4	**Illustrate** the basic usage of memory and construct such memory in terms of array in a program. Students will also be able to define user defined data types using structure and Union. Create and manipulate permanent storage access through File Handling.	**PO1, PO5**
CO5	**Define** and construct different data structures for various collection of data.	**PO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CSE11001	Introduction to Programming	3			2	2									

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech Semester: I Stream: All Program
PAPER TITLE: INTRODUCTION TO PROGRAMMING PAPER CODE: **CSE11001**
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 12 Total No of Pages: 01

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (attempt any two)		
1.	**What** do you understand data types?	**U**	**CO1**
2.	**Define** array?	**U**	**CO4**
3.	**How** user defined function reduces the no. of lines in a large program?	**R**	**CO2**
4.	**Why** pointer is advantageous than array?	**U**	**CO5**
5.	**What** is the size of an integer variable?	**R**	**CO1**
	SECTION B (Attempt any **Two Questions)**		
6.	**What** is dimension of an array? **How** many types of array are there? Can you store integer values and float type values in a single array, if not **why**? **What** you need to do to store such different types of values in an single array?	**U**	**CO4**
7.	**Find** an user defined function in c that would return multiple values in main() function.	**Ap**	**CO3**
8.	Suppose a paragraph is stored in a 2-D character array. **Find** a specific sentence in that paragraph using a c program.	**U**	**CO2/CO4**
9.	State the types of data types and memory occupies. **What** are the ways to convert from one data type to another data type with suitable example?	**U**	**CO1**
	SECTION C is Compulsory		
10.	**How** is it possible to take input in a 2-D array using a single for loop? Make it possible using a suitable program in c.	**U**	**CO4**
11.	**Design** a program in c to determine that a text is written in English or in any other language. If the text is written in any other language convert every character in its nearest English alphabets.	**Ap**	**CO4**
12	**Design** a program to create a pointer to an integer. Allocate memories for 50 elements into that pointer using both malloc() and calloc() function. Display the significance difference of using those two functions to allocate memory. Also state the specific needs of these two functions.	**Ap**	**CO4**

ENG11053	HSSM –I (English Communication)	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	12th level English				
Co-requisites	--				

Course Objectives

1. To know the importance and techniques of communication skills in order to improve professional skills
2. To enhance the knowledge of the students on vocabulary, syntax, and grammatical skills
3. To improve writing skills by applying writing techniques, tools in practice sessions
4. To achieve an overall enhancement in terms of reading, listening and speaking

Course Outcomes

On completion of this course, the students will be able to

CO1. Illustrate the communication processes and to know the practical implications and its challenges at the workplace

CO2. Find the practical uses of English grammar and to use grammar correctly and unambiguously

CO3. Apply different formats of business communication like reports, letters, and other technical writings

CO4. Build competence in speaking, reading, listening, and writing in English.

CO5. Apply English pronunciation and use neutral accent successfully

CO6. Explain comprehend different other accents of spoken English

Course Description

Effective communication is one of the basic requirements of a successful career. Both verbal and nonverbal communication is important to exchange ideas among the employees within the organisation and outside the organisation as well. In this course, the focus will be on improving LSRW skills, i.e. listening, speaking, reading and writing. Students will learn how to communicate effectively through prescribed syllabus. Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as group discussions, role play, small skit enactments, analysis of video scenes and debates. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities and to give an oral group presentation. Students will be expected to interact with media resources, such as, web sites, videos, DVDs, and newspapers etc.

Course Content

Module I: **9 lecture hours**

Communication Level 1: Basics of Communication, Means of Communication, Barriers of Communication

Module II: **9 lecture hours**

Grammar and Syntax Level 1: Tense: types and uses, Idioms, One Word Substitutes, Discussion on the use of Articles and related exercises, Discussion on the use of Prepositions and related exercises,

Exercises on Sentence –Making (Syntax), Practice exercises on Voice change, Class Exercises on Synonyms and Antonyms.

Module III: 9 lecture hours

Reading and Listening Skills Level 1: Introduction to listening skills: purposes and practice, Discussion on types of listening: difference between listening and hearing, Active listening: introduction listening exercises, Elementary level listening exercise, Intermediate level listening exercise, Advance level listening exercise, Introduction to Reading Skills, Strategies of reading, Skimming, Scanning and Summarizing, Comprehension exercises.

Module IV: 9 lecture hours

Speaking Skills Level 1: Introduction to Speaking Skills: Mother tongue influence, Discussion on various kinds of narrative styles and techniques: Welcome speech, Vote of Thanks, Farewell Speech, Debate and Elocution, Class Exercises on Descriptive narration, Practical Exercises on Narration styles, Presentation of small skits, Practicing Extempore in the class, Mock practices of Group discussion, Practicing speaking in pairs, Mock practice of job interviews.

Module V: 9 lecture Hours

Writing Skills Level 1: Business letters: definition, types and format, Practice exercises, Business reports: definition, types and format, Practice exercises, CV and Application letters: types and formats, Practice exercises, Compositions: Essays, precis paragraph writing

Text Books:

1.Kaul Asha. Effective Business Communication. PHI Learning Pvt Ltd. 2014.
2.Wren and Martin. High School Grammar And Composition. S. Chand, 1995.
3.Gupta, A. English Reading Comprehension. Ramesh Publishing House, 2009.

Reference Book:

1.Lewis, Norman. Word Power Made Easy. Anchor: 2014.
2.Riordan, Daniel G & Pauley Steven A. :Technical Report Writing Today. 2004.
3.Hamp-Lyons and Heasely, B . Study Writing; A Course in Written English. For Academic and Professional Purposes, Cambridge Univ. Press, 2006.
4.Quirk R., Greenbaum S., Leech G., and Svartik, J. A Comprehensive Grammar of the English language, Longman:London, 1985.
5.Balasubramaniam, T. A Textbook of English Phonetics for Indian Students. Macmillan: 2012.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	**Illustrate** the communication processes and to know the practical	PO2, PO5, PO9,

	implications and its challenges at the workplace	PO10
CO2	**Find** the practical uses of English grammar and to use grammar correctly and unambiguously	PO2, PO9, PO10
CO3	**Apply** different formats of business communication like reports, letters, and other technical writings	PO5, PO6, PO9, PO10
CO4	**Build** competence in speaking, reading, listening, and writing in English.	PO2, PO3, PO9, PO10
CO5	**Apply** English pronunciation and use neutral accent successfully	PO3, PO9, PO10
CO6	**Explain** comprehend different other accents of spoken English	PO3, PO6, PO9, PO10

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ENG11053	HSSM –I (English Communication)	-	2	2		2	2			3	3	-	1	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

Name: **Enrolment No:**	

Course: ENG11053 – HSSM –I (English Communication)
Program: B.Tech. (All Programs) **Semester: I**
Time: 03 hrs. **Max. Marks:50**
Instructions:
Attempt all questions from **Group A** (each carrying 1 mark); any **Three Questions** from **Group B** (each carrying 5 marks)**; any Two questions from Group C** (each carrying 10 marks)**.**

	Group A (Answer all the questions) (5×1=5)		
1.	**Where** were you ___ 28 February, 2019? (Fill in the blank with appropriate preposition)	**U**	**CO2, CO1**
2.	**What** is non-verbal communication?	**R**	
3.	**Find** one word substitute for: "One who loves books"	**R**	
4.	**What** is the antonym of "Happiness"?	**R**	
5.	Give example of an idiom.	**R**	
	Group B (Attempt any **Three Questions) (3×5=15)**		
6.	**What** are the barriers to communication? **Explain** some physical and psychological barriers of communication	**R**	**CO1**
7.	**What** do you understand by communication? Write a note on the importance of effective communication.	**U**	**CO1**
8.	Fill in the blanks using suitable article. **Find** a copy the sentences given, while answering: i. He was ____ first man to arrive. ii. Would you like to be _____ teacher? iii. I am going to buy _____ hat. iv. Picasso was ____ famous painter. v. The Ganga is ____ sacred river.	**U**	**CO2**
9.	**Change** the following sentences from active to passive voice: i. The cat killed a mouse ii. People lined the road iii. He was singing a song yesterday iv. I have read this book.	**R**	**CO2**

	v. Who broke the jug?		
	Group C (Attempt any **Two Questions) (2×15=30)**		
10.	**Compose** a paragraph on the impact of COVID 19 in our society.	**U**	**CO3**
11.	**Compose** an application to the Vice-Chancellor of your University as the class representative of your respective class requesting permission to organize a science exhibition in your department	**U**	**CO3**
12.	.Read the following passage and **find** the answer the questions that follow. A few countries already use powerful electromagnets to build high speed trains. These trains are called maglev trains. Maglev is the shortened form of magnetic levitation. Maglev trains work on the principles of magnetism and float over a guideway. The maglev train is different from a conventional train in that it does not have an engine. At least it does not have the kind of engines that pull train cars along steel tracks. It does not consume fossil fuels either. Since maglev trains float in the air, there is no friction between the train and the track. This lack of friction and the aerodynamic design of these trains allow them to reach speeds of over 500 kilometer per hour. Japan and Germany pioneer research in the maglev train technology. They have already built their prototypes and are in the process of testing them. Transrapid is an electromagnetic suspension system developed by German engineers. The idea of maglev transportation has been in existence for over a century. The first commercial maglev train made its debut in Shanghai, China in 2002. This train was developed by a German company. Right now the Shanghai Transrapid line connects Longyang Road station and Pudong airport. China is planning to extend this line to Hangzhou by building a 99 miles guideway. Several other countries are also planning to build their own maglev train system, but right now the Shanghai maglev train is the only commercial maglev line. Complete the sentences: (2×5=10) (a) The two main differences between maglev trains and conventional trains are: ……..., …….. (b) Maglev trains are environment friendly because …… (c) The two nations that lead the research in maglev train technology are …….. (d) The two factors that help maglev trains to achieve high speeds are ……. (e) A suitable title for the passage would be …….	**U**	**CO4**

GEE11012	Disruptive Technology Innovations	L	T	P	C
Version 1.0		2	0	0	2
Pre-requisite/Exposure					
Co-requisite					

Course Objectives:

1. Understand the fundamentals of Artificial Intelligence (AI) and Machine Learning (ML)
2. Explore the role of data in Machine Learning
3. Introduction to Natural Language Processing (NLP)
4. Examine the impact of AI on various industries.
5. Introduction to Data Analytics

Course Outcomes:

On the completion of this course the student will be able to

CO1: Analyze the role of data in ML, including preprocessing, tokenization, and basic sentiment analysis in Natural Language Processing (NLP).
CO2: Apply data collection methods and preprocessing techniques to handle missing data and ensure data quality.
CO3: Evaluate the application of cybersecurity in different sectors and discuss emerging trends.
CO4: Analyze safety considerations, standards, and emerging trends in robotics research
CO5: Apply AM and RP in aerospace, automotive, medical, and consumer goods industries.

Course Description:

The course on Disruptive Technologies aims to provide students with an in-depth understanding of various cutting-edge technologies that are reshaping industries and revolutionizing traditional practices. Through a comprehensive curriculum spanning six units, students will delve into Artificial Intelligence/Machine Learning (AI/ML), Data Analytics, Internet of Things (IoT), Cybersecurity, Robotic Process Automation (RPA), and Additive Manufacturing (AM) and Rapid Prototyping (RP).

Course Content

Unit 1: AI/ML Lecture:10

AI/ML: Introduction to Artificial Intelligence; Definition and applications of AI; Importance and impact Of AI in various industries; Machine Learning basics; Distinction between AI and ML; Types of Machine Learning - Supervised, Unsupervised, Reinforcement; Role of data in Machine Learning; Evaluation metrics in ML; Case study of AI implementation in Healthcare and Manufacturing industry; Challenges in AI adoption; Ethics and bias in AI.

NLP: Basics of Natural Language Processing (NLP); Why is NLP required; Text preprocessing and tokenization, Basic sentiment analysis, Applications of NLP in real-world scenarios

Generative AI & Large Language Models: Introduction to generative AI, What are Large Language Models,

Unit 2: Data Analytics with Tools: Lecture:6

Data Analytics: Introduction to Data Analytics; Importance of data in decision-making in industries; Types of Analytics – Descriptive, Prescriptive, Predictive and Preventive; Types of data (Structured / Unstructured); Overview of popular tools MS Excel, R, Tableau & PowerBI

Data collection and preprocessing: Data collection methods; Data cleaning and quality assessment; Dealing with missing data; Data transformation and feature engineering,

Unit 3: IOT Lecture:10

Introduction to IoT: Definition and concept of the Internet Of Things; Significance and impact on various industries; IoT architecture and components overview (Sensors, Actuators, Microcontrollers); Types of sensors (Temperature, Humidity, Motion, Etc.); Sensor characteristics and selection criteria, Actuators and their role in IoT systems; Basics of Arduino and Raspberry Pi.

IoT Applications: Healthcare, Remote Patient Monitoring, Wearable Health Monitoring Devices, Smart Cities, Agriculture and Environmental Monitoring; Basics of Augmented Reality (AR) and Virtual Reality (VR); Digital twins in IoT.

Unit 4: Cyber Security Lecture:9

Introduction to Cybersecurity: Definition and scope; Cyber threats and the need for protection of business data; Overview of common cyber threats (Malware, Phishing, Ransomware, Trojans, Worms); Social engineering as a means for attacks and prevention; Confidentiality, Integrity and Availability (CIA) triad.

Risk Assessment and Management: Security policies and procedures; Best practices.

Security Technologies and Tools: Antivirus software, Firewalls and Intrusion Detection / Prevention Systems (IDS / IPS); Encryption and secure communication; Overview of network security; Steganography and Cryptography.

Unit 5: Robotics and Automation Lecture:6

Robotics and Automation: Types of robots and their applications; Role of automation in various industries; Current trends and future prospects; Robot anatomy and components - DC Motors, Servos, Stepper Motors; Types of robotic end-effectors / Grippers; Pick-and-place operations; Safety considerations and standards.

Applications of Robotics: Cobots (Collaborative Robots), Soft Robotics, Swarm Robotics, Bio-inspired Robotics, Industry 4.0 and Smart Factories.

Unit 6: **Additive Manufacturing (AM) And Rapid Prototyping (RP)** Lecture:6

Basic Principles: Definition and comparison with traditional manufacturing methods; Applications and benefits of AM and RP; Applications - Aerospace and automotive industries, Medical and healthcare applications, Consumer goods and electronics; Challenges of AM and RP

Materials: Plastics, Metals, Ceramics, Composites, Biological Materials

Technologies: Stereolithography (SLA), Fused Deposition Modelling (FDM), Selective Laser Sintering (SLS), Electron Beam Melting (EBM), Polyjet Printing, Binder Jetting, Direct Metal Laser Sintering (DMLS)

BIT11003	Life Sciences	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Class 12 Biology				
Co-requisites	--				

Course Objectives:

1. To acquire the knowledge about the cell structure and interaction with neighboring cells in biological system.
2. To gain the knowledge about the genetic switches and oscillators and evolutionary dynamics.
3. To acquire the knowledge about the transport of molecules in different cellular compartments.
4. To gain the knowledge about dynamics of different systems in human body.
5. To understand the application and significance of different techniques of medical biotechnology.

Course Outcomes

At the end of the course, the student will be able to

CO1 Explain the structure and functions cell organelles and their interrelationship.

CO2 Analyze the genetic switches and evolutionary dynamics of living system.

CO3 Determine the mode of transport of molecules in biological system numerically.

CO4 Compare and contrast between the different networks of human body and other physiological systems and can summarize consequences of physiological disorders.

CO5 Choose or identify different techniques of medical biotechnology on human body to analyse the malfunction of different human system during diseased conditions.

Course Description:

Cell is the structural and functional unit of living organism, it is well known throughout the universe, but mystery the molecular mechanism for performing the different kinds of functions of cell organelle (along with their development in both plant and animal system) and their integration into a beneficial outcome for living organism and as well as the outcome of physiological responses is almost unknown. So the course consists of structure function relationship of cell organelles, trafficking of different molecules between different cellular compartments and their secretion, creation of physiological responses and their assessment by several kinds of instrumentation techniques which can create a common platform between science of engineering and biological science.

Course Content:

Unit I: Cell biology & Communication: [7 hours lecture]

Structure, function, and synthesis of cellular membranes and organelles; cell growth and cancer; cytoskeleton and extracellular matrix; cell cycle; transport, receptors, and cell signaling; functions of specialized cell types.

Unit II: Genetics & Systems Biology [4 hours lecture]

Genetic switches and oscillators, cell-to-cell interactions, cellular and genetic networks, and evolutionary dynamics.

Unit III: Transport & Flow in Biological Systems [7 hours lecture]

Diffusion, osmosis, facilitated, and active transport; Heat Conduction and Radiation; Fluid Dynamics; Heat and Mass Transfer. Electromechanical and physicochemical interactions in cells and biomaterials.

Unit IV: Human Physiology & Diseases [10 hours lecture]

Anatomical, physiological and pathological features of the cardiovascular, respiratory and renal systems. Identifications of deficiencies and diseases from blood, urine and feces; genetic disorders and gene therapy.

Unit V: Neurophysiology [10 hours lecture]

Neuron structure and function; Regeneration of nerve; flow and transport of signals from one neuron to other; Nervous system; Aging and its effect on brain; Behavioral functions of the brain - emotion, memory, learning and consciousness; Disorders of the nervous system and treatment.

Unit VI: Medical Biotechnology [7 hours lecture]

Understanding the handling and usefulness of electrocardiograms, ultrasound images, X-ray images, magnetic resonance images (MRI), computerized tomography (CT) or computerized axial tomography (CAT) images, glucose sensors, and other biosensors.

Text Books

1. Biology for Engineers by Arthur T. Johnson. CRC Press, 1 edition, 2010.
2. New Biology for Engineers and Computer Scientists by AydinTozeren and Stephen W. Byers. Pearson, 1 edition, 2003.

Reference Books

1. Applied Cell and Molecular Biology for Engineers by Gabi Nindl Waite and Lee R. Waite. McGraw-Hill Education, 1 edition, 2007.
2. Samson Wright's Applied Physiology.

Modes of Examination: Assignment/Quiz/Project/Presentation/Written Exam

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Explain** the structure and functions cell organelles and their interrelationship.	**PO12, PSO2**
CO2	**Analyze** the genetic switches and evolutionary dynamics of living system.	**PO2, PO5, PO6, PSO2**

CO3	**Determine** the mode of transport of molecules in biological system numerically.	**PO2, PO5, PSO1, PSO2**
CO4	**Compare** and contrast between the different networks of human body and other physiological systems and can summarize consequences of physiological disorders.	**PO2, PO5, PO6, PO12, PSO2**
CO5	**Choose** or identify different techniques of medical biotechnology on human body to analyse the malfunction of different human system during diseased conditions.	**PO2, PO5, PO6, PO12, PSO1, PSO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
BIT1103	Life Sciences		3		-	3	2	-				-	2	2	3

1=weakly mapped;
2= moderately mapped;
3=strongly mapped

Model Question Paper

Name: **Enrolment No:**	

Name of the Program: B.Tech — Semester: II
Stream: All
PAPER TITLE: Life Science — PAPER CODE: BIT11003
Maximum Marks: 50 — Time duration: 3 hours
Total No of questions: 08 — Total No of Pages: 01

Instructions:
Attempt any three questions from **Section A** (each carrying 5 marks); any **Two Questions** from **Section B** (each carrying 10 marks)**. Section C** is Compulsory (carrying 15 marks)**.**

	Section A (Attempt **any Three)**		
1.	**Discuss** role of different cell organelles in eukaryotic cells.	**U**	**CO1**
2.	**Compare** between Prokaryotic and eukaryotic cells.	**U**	**CO1**
3.	**What** are the consequences of physiological disorders?	**R**	**CO4**
4.	If someone is suffering from cancer, **what treatment can be given to treat the cancerous cells?**	**Ap**	**CO3**
	SECTION B (Attempt any **Two Questions)**		
5.	**Explain** oncogenes. **How** can they affect the cells**? Is this relates with** Tumor suppressive gene? Discuss in detail.	**Ap**	**CO1** **CO2**
6.	a) **What** are the factors influencing living cells and negative as well as positive ways? (4) b) **Explain** different type of networks in human body. (6)	**U**	**CO1** **CO4**
7.	a) **Explain** different techniques of medical biotechnology on human body to analyze the malfunction of different human system during diseased conditions.	**Ap**	**CO5**
	SECTION C is Compulsory		
8.	a) **What** is cell? (2) b) **How** plant cells are different from animal cells? **Explain** any two cell organelles which are considered to be evolved by bacterial cells. (6)	**U** **U**	**CO1**

DGS11001	Design Thinking	L	T	P	C
Version 1.0	Contact Hours – 30	2	0	0	2
Pre-requisites/Exposure	Knowledge of analyzing society problems and product usage problems and a zeal to improve the current situation, in addition to knowing to using laptop/computers, internet, social media interaction, file sharing and uploading, email and communication etiquettes.				
Co-requisites	-				

Course Objectives

1. To enable students to acquire knowledge, imagination and be more assertive on opinions on problems in society.
2. To enable students to learn basics of research, data collection, analysis, brainstorming to find solutions to issues.
3. To make them understand Design Thinking methodologies to problems in field of study and other areas as well.
4. To help students to understand future Engineering positions with scope of understanding dynamics of working between inter departments of a typical OEM.

Course Outcomes

On completion of this course, the students will be able to

CO1. **Examine** design thinking concepts and principles

CO2. **Find** the methods, processes, and tools of design thinking

CO3. **Apply** the Design Thinking approach and model to real world scenarios

CO4. **Analyze** the role of primary and secondary research in the discovery stage of design thinking

Course Description

Design thinking course is a completely online course offered to the first year UG programs across all streams. This course is designed to help understand the steps followed in the process of designing a solution to a problem.

Course Content

Unit I: 2 Lecture Hours

WHAT IS DESIGN THINKING: Designers seek to transform problems into opportunities. Through collaboration, teamwork, and creativity, they investigate user needs and desires on the way to developing human-centered products and/or services. This approach is at the very heart of design thinking.

Unit II: 2 Lecture Hours

THE DESIGN THINKING MODEL: A tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product,

service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

Unit III: **4 Lecture Hours**

PHASE 1: DISCOVER: Begin the design thinking process with the Discover phase, where you will identify the specific problem your design is intended to solve, as well as important usability aspects from those who will use your design. Discovery can be performed through a variety of different research methods which you will learn in this module.

Unit IV: **4 Lecture Hours**

PHASE 2: DEFINE: In the Define phase, you come to understand the problem. We often refer to this as framing the problem. You can do this by using a variety of tools, including storytelling, storyboarding, customer journey maps, personas, scenarios, and more.

Unit V: **4 Lecture Hours**

PHASE 3: DEVELOP: Turn your attention to solving the problem. In this phase you brainstorm custom creative solutions to the problems previously identified and framed. To do this, you conceptualize in any way that helps, putting ideas on paper, on a computer, or anywhere whereby they can be considered and discussed.

Unit VI: **4 Lecture Hours**

PHASE 4: DELIVER: This phase is all about testing and building concepts. Here you take all of the ideas that have been discussed to this point and bring them a little closer to reality by building a concept; something that makes it easier for a user to experience a design. This concept is referred to as a prototype.

Unit VII: **4 Lecture Hours**

PHASE 5: ITERATE: You will test the prototype of your design solution, collecting and acting on feedback received. These actions may mean minor or major revisions to your design, and are repeated as often as necessary until a solution is reached. Tools such as focus groups and questionnaires are used to help you collect feedback that can help with your final design.

Unit VIII: **6 Lecture Hours**

BEYOND DESIGN THINKING: The Design Thinking Model is a tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product, service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

Reference Books

1. Brown, Tim. "What We Can Learn from Barn Raisers." Design Thinking: Thoughts by Tim Brown. Design Thinking, 16 January 2015. Web. 9 July 2015.

2. Knapp, Jake. “The 8 Steps to Creating a Great Storyboard.” Co.Design. Fast Company & Inc., 21 Dec. 2013. Web. 9 July 2015.
3. van der Lelie, Corrie. “The Value of Storyboards in the Product Design Process.” Journal of Personal and Ubiquitous Computing 10.203 (2006): 159–162. Web. 9 July 2015. [PDF].
4. Millenson, Alisson. “Design Research 101: Prototyping Your Service with a Storyboard.” Peer Insight. Peer Insight, 31 May 2013. Web. 9 July 2015.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Examine** design thinking concepts and principles	**PO1, PO11**
CO2	**Find** the methods, processes, and tools of design thinking	**PO1, PO2, PO5**
CO3	**Apply** the Design Thinking approach and model to real world scenarios.	**PO1, PO2, PO11**
CO4	**Analyze** the role of primary and secondary research in the discovery stage of design thinking	**PO1, PO5**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
DGS11 001	Design Thinking	3	2	-		2	-	-	-	-	-	2	-	-	-

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech Semester: I Stream: ECE
PAPER TITLE: Design Thinking
PAPER CODE: DGS11001
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 12 Total No of Pages: 01

Instruction for the Candidate:

- At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
- All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
- Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (Answer All the Questions) (5 x 1 = 5)		
1.	**List** the steps involved in Design Thinking.	**U**	**CO1**
2.	**Estimate** the basic elements of Design Thinking.	**U**	**CO2**
3.	**Define** Napkin Pitch.	**R**	**CO3**
4.	**What** is Assumption testing?	**R**	**CO4**
5.	**Define** the principles of Ethnography.	**U**	**CO2**
	SECTION B (Attempt any **Three Questions) (3 x 5 = 15)**		
4.	Briefly **explain** the importance of ethnography in design thinking?	**U**	**CO2**
5.	**What** are the successive steps for concept development?	**Ap**	**CO3**
6.	**Explain** the different types of concept development strategies.	**Ap**	**CO3**
7.	**Explain** with Example: surface keys for Assumption Testing.	**Evaluate**	**CO4**
	SECTION C (Answer Any Two Questions) (2 x 15 = 30)		
8.	**Explain** in detail about importance of prototyping in Design Thinking.	**U**	**CO4**
9.	**Name** an importance of involving stakeholders in developing new concepts and Plan for conducting experiments within short time and inexpensively.	**Create**	**CO3**
10.	**Distinguish** between design thinking and visualization of a problem.	**An**	**CO1**

PHY12202	Applied Science Lab	L	T	P	C
Version 1.0	Contact Hours - 30	0	0	2	2
Pre-requisites/Exposure	Basics of knowledge of higher secondary level physics & Chemistry				
Co-requisites					

Course Objectives

1. To understand the experiments on general properties of matter.
2. To apply the knowledge of physical optics in different practical experiments.
3. To analyse different experiments on electrical and electronic science.
4. To explore different experiments related to fundamental knowledge on quantum mechanics.
5. To impart a scientific approach and to familiarize the applications of chemistry in the field of technology
6. An ability to gain knowledge about different types of qualitative and quantitative estimation

Course Outcomes

On completion of this course, the students will be able to

CO1. Illustrate about the elastic and other general properties of matter and their measurements.
CO2. Acquire the knowledge of physical optics and experimental techniques to verify them.
CO3. Develop the basic concepts related to electrical circuits.
CO4. Find the fundamental knowledge of basic quantum mechanics and few experiments related to it.
CO5. Acquire the basic information about semiconductor material and devices.
CO6. Develop the qualitative idea of thermo-electric currents and technique to measure it.
CO7. Illustrate and practice different techniques of quantitative chemical analysis generate experimental skills and apply these skills to various analyses
CO8. Analyze the quality of water by determining its hardness & alkalinity.
CO9. Utilize the fundamental laboratory techniques for analyses such as titrations

Course Description

Applied Science Labis used to apply existing scientific knowledge to develop more practical applications, for example: technology or inventions. In applied Science Labdifferent aspects of basic andmodern physics has been explored. Applied Science Labis generally developing technology, although there might be dialogue between basic science and applied science (research and development). In this course the focus will be on improving the logical learning moved into a physical environment.

Chemistry lab is a place where laboratory sessions is to enable the learners/students to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering. The course also includes theory on sampling, analyses of real samples, risk assessment of chemical experiments, important steps and procedures in analytical chemistry, and evaluation/interpretation of results.

Course Content

Experiments: Physics

2. Determination of Young's Modulus of a Beam by traveling microscope by FLEXURE method.
3. Carry Foster's Method to Determine Resistance of a Given Coil.

4. Determination of the Coefficient of viscosity of water by Poiseulle's Capillary Flow method.
5. To determine the wavelength of sodium light by forming Newton's Ring.
6. Determination of Rigidity Modulus by dynamical method.
7. Determine the Plank's constant using photocell.
8. To verify Stefan's law by electrical method.
9. To study the temperature dependence of reverse saturation current in a junction diode and hence to determine the Band gap.
10. Determination of specific charge(e/m) of electron by J.J. Thomson's method.
11. Determination of the Rydberg constant by studying hydrogen or helium spectrum.
12. Determination of dielectric constant of a given dielectric material.
13. Determination of Hall coefficient of Semiconductor.
14. Study current – voltage characteristic load response of photovoltaic solar cells.

Experiments: Chemistry (Any Four)

1. Determination of total hardness of water by complexometric titration method
2. Determination of carbonate and bicarbonate in water
3. Estimation of iron (ferrous ion in Mohr salt) by permanganometry.
4. Determination of strength of an unknown HCl solution with standardized NaOH solution by conductometric titration.
5. Dissolved oxygen by Winkler's method

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

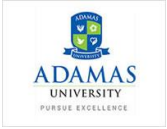
Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Illustrate** about the elastic and other general properties of matter and their measurements.	**PO1**
CO2	**Acquire** the knowledge of physical optics and experimental techniques to verify them.	**PO1, PO5**
CO3	**Develop** the basic concepts related to electrical circuits.	**PO1, PO5**
CO4	**Find** the fundamental knowledge of basic quantum mechanics and few experiments related to it.	**PO1**
CO5	**Acquire** the basic information about semiconductor material and devices.	**PO1, PO5**
CO6	**Develop** the qualitative idea of thermo-electric currents and technique to measure it.	**PO1, PO3**
CO7	**Illustrate** and practice different techniques of quantitative chemical analysis generate experimental skills and apply these skills to various analyses	**PO1, PO3, PO9**

CO8	**Analyze** the quality of water by determining its hardness & alkalinity.	**PO3, PO9**
CO9	**Utilize** the fundamental laboratory techniques for analyses	**PO3, PO9**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
PHY1 2202	Applied Science Lab	3		2	-	2	-	-	-	2	-	-	-	-	-

1=weakly mapped
2=moderately mapped
3=strongly mapped

Name: **Enrolment No:**	

Course: PHY12202 – Applied Science Lab

Program: B.Tech. **Semester: ODD 2020-21**

Time: 03 hrs. **Max. Marks: 50**

SAMPLE QUESTIONS

1.	**Determine** Young's Modulus of a Beam by traveling microscope by FLEXURE method	**Ap**	**CO1**
2.	Carry Foster's Method to **Determine** Resistance of a Given Coil.	**Ap**	**CO1**
3.	**Determine** the Coefficient of viscosity of water by Poiseulle's Capillary Flow method.	**Ap**	**CO1**
4.	**Determine** the wavelength of sodium light by forming Newton's Ring.	**U**	**CO2**
5.	**Determine** Rigidity Modulus by dynamical method.	**Ap**	**CO1**
6.	**Determine** the Plank's constant using photocell.	**U**	**CO2**
7.	**Show** Stefan's law by electrical method.	**Ap**	**CO3**
8.	**Show** the temperature dependence of reverse saturation current in a junction diode and hence to **determine** the Band gap.	**U**	**CO4**
9.	**Determine** specific charge(e/m) of electron by J.J. Thomson's method.	**Ap**	**CO5**
10.	**Determine** the Rydberg constant by studying hydrogen or helium spectrum.	**Ap**	**CO6**
11.	**Determine** dielectric constant of a given dielectric material.	**U**	**CO5**
12.	**Determine** Hall coefficient of Semiconductor.	**U**	**CO5**
13.	**Show** current – voltage characteristic load response of photovoltaic solar cells.	**U**	**CO6**
14.	Experiments: Chemistry (Any Four) 1. **Determine** total hardness of water by complexometric titration method 2. **Determine** carbonate and bicarbonate in water 3. **Estimate** iron (ferrous ion in Mohr salt) by permanganometry. 4. **Determine** strength of an unknown HCl solution with standardized NaOH solution by conductometric titration. 5. Dissolve oxygen by Winkler's method	**Ap** **U** **Ap** **U** **Ap**	**CO7, CO8, CO9**

CSE12002	**Programming Lab**	L	T	P	C
Version 1.0	**Contact Hours – 45**	0	0	3	2
Pre-requisites/Exposure	10+2 Level Mathematics, Knowledge of Basics of Computer				
Co-requisites	Knowledge of Logical Reasoning and Analysis				

Course Objectives

1. To comprehend the practical nature of programming by solving through computer systems.
2. To practice the programming construct to solve multi-dimensional problems.
3. To relate and implement mathematical concepts through programming in order to solve computational problems.
4. To enable students to acquire structure and written expression required for their profession.
5. To understand the principles of data storage and manipulation.

Course Outcomes

On completion of this course, the students will be able to

CO1. **List** and memorize various Unix commands. Also, students be able to construct various basic programs and appraise them.
CO2. **Design** and execute iterative statement in a program. Also, students be able to differentiate among different iterative structure.
CO3. **Construct** such programs that used to define user defined functions and to design library functions.
CO4. **Develop** array concept in 1-Dimensional and 2-Dimensional construct. Hence be able to design string functions to cater to various character array related problem.
CO5. **Find** the concept of Stack, Queue, and Linked List and appraise them in different cases.

Course Description

Practical Programming skills are mandatory for designing or solving problems through digital device by implementation. To develop any software the behavior of a programming language is a must through problem solving. In present era almost all aspect of life is somehow largely related to virtualization and digital data/information. Devices from smartphones to other handheld devices, drones, cameras, medical instruments etc. all needs programming at some part. In engineering it has become quintessential for the students/research scholars to learn programming. In this course, students will learn how to solve problems in various domains through a programming language. This course enables students with the basic skills of C Programming Language. Five Different related modules comprise this course. First Unit familiarizes students with basics of computers, algorithmic method to solve problem, introduction to generic programming construct. Basics of C Programming is upto iterative structure is depicted in Unit II. In Unit III students will learn about modularization using functions and one advance concept of C Programming, Pointers. Unit IV will cover one of the most important concepts in C Programming, Array and Strings. Unit V will accomplish this course with the advance concept like Structure, Union and File Handling. After this course students will grow their analytical ability to solve problem and logical skill. Also, this course effectively creates the ability to grasp any other Programming Language in easier manner. In all these modules related programming problems are practiced to understand the syntactical and semantical correctness of a program. Gradually students become more comprehensive through the progress of the course.

Course Content

Experiments:

1. Familiarization with LINUX commands and vi editor.
2. Programs to demonstrate Decision Making, Branching and Looping, Use of break and continue statement etc.
3. Implementation involving the use of Arrays with subscript, String operations and pointers.
4. Implementation involving the use Functions and Recursion.

5. Implementation involving the use Structures and Files.
6. Implementation based on Stack Queues and Linked List for example Insertion and Deletion.

Text Books

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: McGraw-hill.
2. Gotfreid (196) *Schaum's Outline of Programming with C*, 2nd ed., USA: McGraw-Hill
3. Brian W. Kernighan, Dennis Ritchie (1988) *C Programming Language*, 2nd ed., : Prentice Hall.
4. Das Sumitabha, UNIX Concepts and Applications, 4th Ed., New Delhi, Tata McGraw-Hill

Reference Books

1. Al Kelley, Ira Pohl (1988) *A Book on C*, 4th ed. Addision Wesley Longman

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**List** and memorize various Unix commands. Also, students be able to construct various basic programs and appraise them.	**PO4**
CO2	**Design** and execute iterative statement in a program. Also, students be able to differentiate among different iterative structure.	**PO1, PO4, PO5**
CO3	**Construct** such programs that used to define user defined functions and to design library functions.	**PO1**
CO4	**Develop** array concept in 1-Dimensional and 2-Dimensional construct. Hence be able to design string functions to cater to various character array related problem.	**PO1**
CO5	**Find** the concept of Stack, Queue, and Linked List and appraise them in different cases.	**PO1, PO5**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CSE12002	Programming Lab	3			2	2									

1=weakly mapped
2= moderately mapped
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech Semester: I Stream: ECE
PAPER TITLE: PROGRAMMING LAB PAPER CODE: CSE12002
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 12 Total No of Pages: 01

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (attempt any two)		
1.	**What** do you understand data types?	**U**	**CO1**
2.	Define array?	**R**	**CO4**
3.	**How** user defined function reduces the no. of lines in a large program?	**R**	**CO2**
4.	**Why** pointer is advantageous than array?	**R**	**CO5**
5.	**What** is the size of an integer variable?	**R**	**CO1**
	SECTION B (Attempt any **Two Questions)**		
6.	**What** is dimension of an array. How many types of array are there? Can you store integer values and float type values in a single array, if not why? What you need to do to store such different types of values in an single array?	**R**	**CO4**
7.	**Design** an user defined function in c that would return multiple values in main() function.	**Ap**	**CO3**
8.	Suppose a paragraph is stored in a 2-D character array. **Find** a specific sentence in that paragraph using a c program.	**U**	**CO2/CO4**
9.	State the types of data types and memory occupies. **What** are the ways to convert from one data type to another data type with suitable example?	**U**	**CO1**
	SECTION C is Compulsory		
10.	**How** is it possible to take input in a 2-D array using a single for loop? Make it possible using a suitable program in c.	**Ap**	**CO4**
11.	**Design** a program in c to determine that a text is written in English or in any other language. If the text is written in any other language convert every character in its nearest English alphabets.	**U**	**CO4**
12	**Design** a program to create a pointer to an integer. Allocate memories for 50 elements into that pointer using both malloc() and calloc() function. Display the significance difference of using those two functions to allocate memory. Also state the specific needs of these two functions.	**U**	**CO4**

CEE12001	Engineering Drawing & CAD	L	T	P	C
Version1.0		0	0	4	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To comprehend general projection theory, with an emphasis on the use of orthographic projection to represent three-dimensional objects in two-dimensional views.
2. To understand the application of industry standards and techniques applied in engineering drawing.
3. To apply auxiliary or sectional views to most practically represent engineered parts.
4. To Dimension and explain two-dimensional engineering drawings.
5. To employ freehand 3D pictorial sketching to aid in the visualization process and to efficiently communicate ideas graphically.

Course Outcomes

On completion of this course, the students will be able to

CO1. Identify the principle and significance of engineering drawing along with all the possible geometrical shapes.
CO2. Infer the principle and concept of projection of Points, Lines and Planes over Auxiliary Planes.
CO3. Demonstrate the principle and concept of Projection of Regular Solids.
CO4. Illustrate Sections and Sectional Views of Right Angular Solids and Regular Solids.
CO5. Interpret Isometric projection.

Course Description

In this fundamental course, students will be introduced to the basics of engineering drawing. Terms and definitions used in industries, such as manufacturing and construction, may also be covered. Specific skills introduced in this course may include sketching, geometric construction, auxiliary drawing, computing dimensions and lettering. Students will be also introduced to computer-aided drawing (CAD) software or techniques.

Course Content

Module 1 **Contact Hr. 9**

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2 **Contact Hr. 9**

Orthographic Projections covering, Principles of Orthographic Projections Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

Module 3 **Contact Hr. 8**

Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views.

Module 4 **Contact Hr. 9**

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

Module 5 **Contact Hr. 10**

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

Reference Books

1. Engineering Drawing, N. D. Bhat, Charotar Publishing House (2012).

2. Shah, M.B. & B.C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education.

3. Engineering Drawing & Graphics using Autocad, T. Jeyapoovan, Vikas Publishing House Pvt. Ltd.-Noida; Third edition (2010).

4. https://nptel.ac.in/courses/112103019/

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs), Program Outcomes (POs)& PSOs

Mapping between COs, POs and PSOs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Identify** the principle and significance of engineering drawing along with all the possible geometrical shapes.	**PO2, PO3, PO12, PSO2**
CO2	**Infer** the principle and concept of projection of Points, Lines and Planes over Auxiliary Planes.	**PO2, PO9, PO3, PO12**
CO3	**Demonstrate** the principle and concept of Projection of Regular Solids.	**PO3, PO9, PSO2, PO12**
CO4	**Illustrate** Sections and Sectional Views of Right Angular Solids and Regular Solids.	**PO3, PO9, PO12, PSO2**
CO5	**Interpret** Isometric projection.	**PO2, PO9, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Competitive Examination Preparation	Technical Competency
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CEE12001	Engineering Drawing & CAD	-	3	3	-	-	-	-	-	3	-	-	3	-	3

1=weakly mapped 2= moderately mapped 3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY PURSUE EXCELLENCE	**ADAMAS UNIVERSITY** **END SEMESTER EXAMINATION** (Academic Session: 2020 – 21)		
Name of the Program:	B.Tech in CE	**Semester:**	I & II
Paper Title:	Engineering Drawing & CAD	**Paper Code:**	CEE12001
Maximum Marks:	50	**Time Duration:**	3Hrs
Total No. of Questions:	10	**Total No of Pages:**	1
(Any other information for the student may be mentioned here)	**1.** At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam. **2.** All parts of a Question should be answered consecutively. Each Answer should start from a fresh page. **3.** Assumptions made if any, should be stated clearly at the beginning of your answer.		

Instructions to the Students: Attempt at least 1 Question from each CO.

	Follow the instruction given by Lab Instructor during the exam		
1	A water tank of size 27 m^3 was represented in the drawing by 216 cm^3 size. Construct a vernier scale for the same to measure up to 5 metre. Also show on it the distance of 3.75 m, 0.27 m and 0.04 m.	**CO1**	**U**
2	A rectangular plot of land measuring 2.56 hectors is represented on a map by a similar rectangle of 16 sq. cm. Calculate RF of the scale. Draw a diagonal scale to read single meter. Show a distance of 368 m on it. (1 hector = 10^4 sq. meter)o	**CO1**	**R**
3	A point R is on HP and 35 mm in front of VP. Another point M is on VP and below HP. The line joining their front views make an angle of 30 deg to the reference line, while the line joining their top views makes an angle of 45 deg with the reference line. Find the distance of the point Q from HP.	**CO2**	**U**
4	Two points A and B are on HP. The point A is 35 mm in front of VP, while B is 50 mm behind VP. The line joining their top views makes an angle of 40 deg with XY. Find the horizontal distance between the two projectors.	**CO2**	**App**
5	Draw the projections of a regular hexagon of 25 mm sides, having one of its side in the H.P. and inclined at 60º to the V.P. and its surface making an angle of 45º with the H.P.	**CO3**	**U & App**
6	A cone of 40 mm diameter and 50 mm axis is resting on one generator on HP, which makes 30 deg inclinations with VP. Draw its projections.	**CO3**	**U & App**
7	A cylinder 40 mm diameter and 50 mm axis is resting on one point of a base circle on VP while it's axis makes 45^0 with VP and FV of the axis 35^0 with HP. Draw projections.	**CO4**	**R**
8	A square pyramid 30 mm base side and 50 mm long axis is resting on it's apex on HP, such that it's one slant edge is vertical and a triangular face through it is perpendicular to VP. Draw its projections.	**CO4**	**U & App**
9	A pentagonal pyramid of base side- 30 mm, and axis length- 60 mm is resting on HP on its base with a side of base perpendicular to VP. Draw the isometric projections.	**CO5**	**U & App**
10	A frustum of cone base diameter-50 mm, top diameter- 25 mm and height- 50 mm is placed centrally on a cylindrical slab of diameter-100 mm and thickness-30 mm. HP on its base with a side of base perpendicular to VP. Draw the isometric projection of the combination.	**CO5**	**U & App**

Semester-II

MTH11502	Engineering Mathematics-II	L	T	P	C
Version 1.0	Contact Hours - 60	3	1	0	4
Pre-requisites/Exposure	12th level Mathematics & Engineering Mathematics-I				
Co-requisites	--				

Course Objectives

1. To help the student to understand the basic concepts of matrix theory with its uses in engineering science.
2. To give emphasis about concepts of Eigen vlue and Eigen vector, vector space and linear transformation and enable students to apply these topics for analysing engineering problems.
3. To help the student to understand the use of vector calculus in engineering.
4. To give the students a perspective to learn about functions of complex variables, pole, and residues and their importance in advanced study of engineering science.
5. To enable students to acquire the knowledge of different transformation techniques and their applications in engineering science.

Course Outcomes

On completion of this course, the students will be able to

CO1 **Apply** the knowledge of matrix theory for finding solution of a related engineering problem

CO2 **Illustrate** the Eigen value(s) and Eigen vector(s) of a matrix

CO3 **Explain** the concept of vector space and linear transformation between the vector spaces

CO4 **Build** the knowledge of vector calculus and apply it for solving related problems

CO5 **Develop** the concept of complex variable and its application

CO6 **Outline** the Fourier series representation of a function

CO7 **Make use of** appropriate transformation technique for solving differential equation or difference equation

Course Description

For any engineering program, Mathematics is the backbone. With a sound knowledge in fundamental mathematics, an engineering student can become a very skillful engineer. In this course, the focus will be on learning Mathematics in depth, which will motivate students to grow their thinking ability in different fields of engineering. Students will be able to apply this knowledge to tackle almost all kinds of problems in engineering and science successfully. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities (Problem solving, presentation etc.).

Course Content

Unit I: Sequences and Series [15L]

Sequences and their limits, convergence of series, Convergence Test (comparison test, Ratio test, Root test), Absolute and conditional convergence, Alternating series, Power series

Periodic functions, Definition of Fourier series, Euler's formulae, Dirichlet conditions, Change of interval, Even and odd functions, half range Fourier Sine & Cosine series

Unit II: Complex Variables [15L]

Limit, continuity, differentiability and analyticity of complex functions, Cauchy-Riemann equations, derivatives of analytic functions, line integrals in complex plane, Cauchy's integral theorem, independence of path, existence of indefinite integral, Cauchy's integral formula, Taylor's series, Laurent's series, zeros and singularities, Residue theorem

Unit III: Ordinary Differential Equations [20L]

Formation of ODE, order and degree, First order ODE, Method of separation of variables, Exact and non-exact equations, linear and Bernoulli's form, second order differential equations with constant coefficients, Complementary functions and Particular Integral, D-operator, method of variation of parameters, general linear differential equations with constant coefficients, Cauchy-Euler's equations, Simultaneous differential equations

UnitIV: Vector Calculus [10L]

Ordinary Integrals of Vectors, Line, surface and volume integrals of Vector fields, Gauss' divergence theorem, Green's and Stokes Theorems and their applications

Text Book:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House

Reference Book:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications
2. G. B. Thomas Jr., M. D. Weir, J. R. Hass, Thomas Calculus Early Transcendentals, 12th Edition
3. James Stewart, Calculus: Concepts and Contexts, 4th Edition, Cengage Learning

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Apply** the knowledge of matrix theory for finding solution of a related engineering problem	**PO1, PO2, PO3, PO4**

CO2	**Illustrate** the Eigen value(s) and Eigen vector(s) of a matrix	**PO1, PO2, PO3, PO4**
CO3	**Explain** the concept of vector space and linear transformation between the vector spaces	**PO1, PO2, PO3, PO4**
CO4	**Build** the knowledge of vector calculus and apply it for solving related problems	**PO1**
CO5	**Develop** the concept of complex variable and its application	**PO2, , PO5**
CO6	**Outline** the Fourier series representation of a function	**PO1, PO2, PO3, PO4, PO5**
CO7	**Make use of** appropriate transformation technique for solving differential equation or difference equation	**PO1, PO2, PO3, PO5**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
MTH11502	Engineering Mathematics-II	3	3	3	2	2	-		-	-	-	-		-	-

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech Semester: II Stream: All
PAPER TITLE: Engineering Mathematics-II
PAPER CODE: MTH11502
Maximum Marks: 50 Time duration: 3 hours
Total No of questions: 12 Total No of Pages: 02

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (Answer All the Questions) (5 x 1 = 5)		
1.	**Estimate** the inverse z-transform of the function $F(z) = \frac{1}{z-2}$.	**Ap**	**CO07**
2.	**Find** the polar form of $-1 + i$.	**Ap**	**CO05**
3.	**What** is the Laplace transform of $f(t) = t^2 e^{-at}$?	**Ap**	**CO07**
4.	**What** is the Fourier series representation for an odd function $f(x)$ in the interval $-\pi \le x \le \pi$.?	**U**	**CO06**
5.	If $A = \begin{pmatrix} 0 & 2 \\ 0 & 4 \end{pmatrix}$, **Show** A as a sum of a symmetric and skew symmetric matrices.	**Ap**	**CO01**
	SECTION B (Attempt any **Three Questions) (3 x 5 = 15)**		
4.	**Solve** Cayley-Hamilton theorem for $A = \begin{pmatrix} 0 & 0 & 1 \\ 3 & 1 & 0 \\ -2 & 1 & 4 \end{pmatrix}$.	**U, Ap**	**CO01 & CO02**
5.	**Determine** the Fourier sine integral representation of $f(x) = \begin{cases} 1 & for\ 0 \le x \le \pi \\ 0 & for\ \ x > \pi \end{cases}$ and hence evaluate $\int_0^\infty \frac{1-\cos \pi\lambda}{\lambda} \sin \lambda x \, d\lambda$.	**U**	**CO06**
6.	**Define** Harmonic function. Prove that $H(x, y) = e^{-y} Sin\, x$ is a harmonic function.	**Ap**	**CO05**
7.	**Find** the inverse Z-transform of $F(z) = \frac{(3z^2 - z)}{(z-2)(z-3)(z-4)}$, using partial fraction method.	**Ap**	**CO07**

	SECTION C (Answer Any Two Questions) (2 x 15 = 30)		
8.	(i) **Determine** the analytic function $f(z) = u + iv$, if $u = e^x(x\,Cosy - y\sin y)$. (ii) **Evaluate** the line integral $\int_i^{2-i}(3xy + iy^2)dz$ along the line $x + y = 1$. **7+8**	**Ap**	**CO04 & CO05**
9.	(i) **Evaluate** the integration using Residue theorem $\int_c \frac{dz}{(z-1)(z-2)(z-3)}$ where $c: \lvert z\rvert = \frac{5}{2}$ (ii) **Determine** the Laplace transform of the following function $f(t) = \frac{e^{-at} - cosbt}{t}$ **8+7**	**U, Ap**	**CO05 & CO06**
10.	(i) Let V be the set of all ordered pairs of real numbers with vector addition **define** as $(x, y) + (x', y') = (x + x' + 1, y + y' + 1)$ **Show** that the first five axioms for vector addition are satisfied. Clearly mention the zero vector and additive inverse. (ii) **Summarize** the conditions for which the system $x + y + z = 1$ $x + 2y - z = k$ $5x + 7y + az = k^2$ Admits (i) No solution (ii) Only one solution (iii) Infinitely many solution. **8+7**	**U**	**CO3**

GEE11001	Electrical and Electronics Technology	L	T	P	C
Version 2.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Idea about basic mathematics				
Co-requisites	Basic idea of semiconductor devices and electromagnetism				

Course Objectives

1. To understand dc network theorems and apply these theorems to calculate the voltage, current and power for a given circuit.
2. To explain the concept of active power, reactive power, power factor, quality factor, steady state sinusoids.
3. To familiarize with passive components, active components and measuring instruments.
4. To familiarize the working of diodes, transistors, MOSFETS and integrated circuits.
5. To implement mini projects based on concept of electronics circuit concepts.

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain DC network theorems and apply these theorems to calculate the voltage, current and power for a given circuit.

CO2. Describe the concept of active power, reactive power, power factor, quality factor, steady state sinusoids.

CO3. Illustrate three-phase power measurement.

CO4. Apply knowledge about different passive components used in electronic industry for common application.

CO5. Illustrate with the working of different active components to demonstrate basic electronic circuits.

CO6. Describe the basic construction of measuring instruments and digital logic circuits used for different electronics applications.

Course Description

Present technology requires necessary knowledge of ELECTRONICS in most fields like Telephony and Telegraphy, Optical Communication, Wireless Communication, Television Communication, Health Services, etc. The electronics is used in instrumentation applications such as the cathode ray oscilloscope (CROs), frequency counters, pulse and signal generators, digital multimeters, power supplies, pH meters, strain gauges etc. The electronic is used in industrial applications also. The electronic is used in defense applications such as RADAR (Radio Detection and Ranging). The electronics is used in medical applications like X ray equipment, Electro cardiograph (ECG), Electro encephalograph (EEG), Cathode ray oscilloscope (CRO), short wave diathermy units, ultrasound scanner and etc. Electronics is growing every day and recent trends in embedded systems are also happening with the Internet of things. Home appliances are talking to each other without human intervention. Robots are making home jobs and thus reducing the human effort. Consumer appliances are making life simpler with cutting-edge technologies implemented by top electronic companies like Samsung, Google, LG, Sony, and Philips etc.

Course Content

Unit I: 7 lecture hours

D.C. Circuit Analysis and Network Theorems: Concept of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, R, Land C as linear elements, source transformation, Kirchoff's Law, mesh analysis and nodal analysis, star-delta

transformation, network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem, network analysis with dependent sources.

Unit II: 7 lecture hours

Steady State Analysis of Single Phase A.C. Circuits: Sinusoidal, square and triangular waveforms-average and effective value, form the peak factors, concept of phasor, phasor representation of sinusoidal voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, power factor, causes and problems of low power factor, power factor improvement, resonance in series and parallel circuits, bandwidth and quality factors.

Unit III: 6 lecture hours

Three Phase A.C. Circuits: Its necessity and advantages, meaning of phase sequence, star and delta connections, balanced supply and balanced load, line and phase voltage/current relation, three phase power measurements, two wattmeter method.

Unit IV: 6 lecture hours

Basics of Semi-Conductors and PN Junction: Introduction; Carrier Concentrations- the Fermi Level; Electron and Hole Concentration at Equilibrium; Temperature Dependence of Carrier Concentration; Drift and diffusion current; PN Junction Diode in Equilibrium Conditions; Depletion Region formation, PN Junction Diode in Forward Biased and Reverse Biased Condition; Breakdown in PN Junction Diodes.

Unit V: 6 lecture hours

Bipolar Junction Transistors: Introduction, Types: NPN and PNP; Current Components; Early Effect; Different Configurations of a Transistor and its Characteristics; Brief overview of DC biasing, Operating Point, Transistor as an Amplifier (CE, CB, CC); Transistor as a Switch

Unit VI: 6 lecture hours

Field Effect Transistors: Introduction, JFET and MOSFET, Characteristics of JFETs and MOSFETs; Analysis of MOS structure; Calculation of threshold voltage; I-V characteristics of MOSFETs.

Unit VII: 7 lecture hours

Electronics Instruments & Digital Electronics Fundamental:

Signal generator, Multimeter, operation of CRO and its application. Number systems, Conversions and codes, Logic gates and truth tables.

Text Books

1. Electronic Devices & Circuit Theory: Boyelstad & Nashelsky
2. Electronics Fundamental and application: D.Chattopadhyay and P C Rakshit
3. Electronic Principle: Albert PaulMalvino
4. Digital circuits and design by S Salivahanan and SArivazhagan
5. V. N. Mittal and A. Mittal, *Basic Electrical Engineering*, Tata McGraw-Hill Publishing Company Ltd,2006.

Reference Books

1. Electronic Circuits, Discrete and Integrated- Charles Belove and Donald L.Schilling
2. Principles of Electrical Engineering and Electronics-VK Mehta, Rohit Mehta, SChand and Company, New Delhi
3. Solid State Electronic Devices- Ben G. Streetman and Sanjay Kumar Banerjee, PHI.
4. Fundamental of Digital Circuits by Anand Kumar 2nd Eddition, PHI Learning Pal, Rajendra and Korlahalli, J.S. (2011) Essentials of Business Communication. Sultan Chand & Sons. ISBN: 9788180547294.
5. Theodore Wildi,*ElectricMachines, Drives and Power Systems*, Pearson,2005.

6. Vincent Del Toro, *Electrical Engineering Fundamentals*, 2nd Ed., Prentice Hall India Learning Pvt. Ltd.,1989.
7. J. Millman, C. Halkias and C. D. Parikh, *Millman's Integrated Electronics: Analog and Digital Circuits and Systems*, 2nd Ed., McGraw Hill Education,2017.
8. D.P.Leach,A.P.MalvinoandG.Saha,*DigitalPrinciplesandApplications*,8thEd.,McGraw Hill Education,2014.

Modes of Evaluation: Quiz/Assignment/ Written Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Explain DC network theorems and apply these theorems to calculate the voltage, current and power for a given circuit.	**PO1, PO2**
CO2	Describe the concept of active power, reactive power, power factor, quality factor, steady state sinusoids.	**PO2, PO3**
CO3	Illustrate three-phase power measurement.	**PO2, PO6**
CO4	**Apply** knowledge about different passive components used in electronic industry for common application.	**PO1, PO3, PO6**
CO5	**Illustrate** with the working of different active components to demonstrate basic electronic circuits.	**PO1, PO3, PO6, PO12**
CO6	**Describe** the basic construction of measuring instruments and digital logic circuits used for different electronics applications.	**PO1, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
GEE11001	Electrical and Electronics Technology	3	3	3	1	-	2	-	-	-	-	-	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

MEE11002	Engineering Mechanics	L	T	P	C
Version 1.0	Contact Hours – 60	3	1	0	4
Pre-requisites/Exposure	12th level Physics, Mathematics				
Co-requisites	--				

Course Objectives

1. To enable learners to solve force problems related to practical world.
2. To be able to determine the centroid, centre of gravity and moment of inertia.
3. To learn the effect of friction on equilibrium.
4. To learn kinematics, kinetics of particle and rigid body, related principles.
5. To introduce the concepts of Dynamic motion.

Course Outcomes

On completion of this course, the students will be able to

CO1. **Apply** conditions of equilibrium of bodies subjected to forces
CO2. **Determine** the centroid, centre of gravity and moment of inertia of various one dimensional and two-dimensional objects
CO3. **Analyze** motion under the effect of dry friction
CO4. **Apply** the concept of virtual work for bodies in equilibrium
CO5. **Apply** the D'Alembert's Principle for reducing the problem of kinetics to equivalent statics problem.

Course Description

Engineering Mechanics. This is a basic first level course to learn rigid body mechanics covering both statics and dynamics. Statics covers free body diagrams, equilibrium of rigid bodies, analysis of trusses and beams, discussion on friction, virtual work and stability. Students will be expected to be familiar with engineering problems related to practical field.

Course Content

Module 1 **15 lecture hours**

Basics of Statics and Concurrent Forces
Statics of Particles: Force System: Force, classification & representation, force as a vector, composition and resolution of forces, principle of superposition and transmissibility of forces.
Statics of Rigid bodies: Equilibrium of coplanar force system, free body diagrams, determination of reactions, equilibrium of a body under three forces, Lami's theorem. Moment of a force about a point and an axis, moment of coplanar force system, Varignan's theorem.

Module 2: **15 lecture hours**
Parallel and Distributed Forces
Parallel forces in a plane, Distributed Parallel forces in a plane, couple, resolution of a force into a force and a couple, moment of a couple.
Centroid and Moment of Inertia: Determination of centre of gravity, centre of mass and centroid by direct integration and by the method of composite bodies, area moment of inertia of composite plane figures and mass moment of inertia, radius of gyration, parallel axis theorem, Pappas theorems, polar moment of inertia.

Module 3: **10 lecture hours**

Friction Introduction to wet and dry friction, laws of dry friction, cone of friction, block friction, ladder friction, wedge friction, application of friction in machines.

Module 4: **10 lecture hours**

Virtual Work Virtual displacement, principle of virtual work.

Module 5: **10 lecture hours**

Introduction to Dynamics Laws of motion, Projectile motion, D'Alembert's Principle, Work and energy, impulse and momentum, impact of bodies.

Text Books

1. Engineering Mechanics [Vol-I & II] by Meriam&Kraige, 5th ed. – Wiley India
2. Engineering Mechanics by S.S. Bhavikatti and K.G. Rajashekarappa – New Age International
3. Mechanics of Solids by Crandall,Dahl and Sivakumar-MC Graw Hill ,5th Edition 2015,New Delhi

Reference Books

1. Engineering Mechanics: Statics & Dynamics by I.H.Shames, 4th ed. – PHI
2. Engineering Mechanics by Timoshenko, Young and Rao, Revised 4th ed. – TMH

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Apply** conditions of equilibrium of bodies subjected to forces	**PO1, PO2**
CO2	**Determine** the centroid, center of gravity and moment of inertia of various one dimensional and two-dimensional objects	**PO1, PO2**
CO3	**Analyze** motion under the effect of dry friction	**PO1, PO2**
CO4	**Apply** the concept of virtual work for bodies in equilibrium	**PO1, PO2**
CO5	**Apply** the D'Alembert's Principle for reducing the problem of kinetics to equivalent statics problem.	**PO1, PO2,**

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
MEE11002	Engineering Mechanics	3	3												

1=weakly mapped
2= moderately mapped
3=strongly mappe

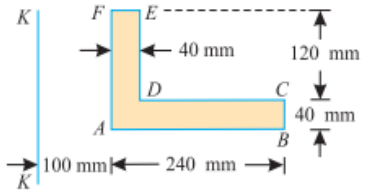
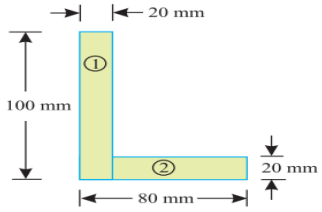
Model Question Paper

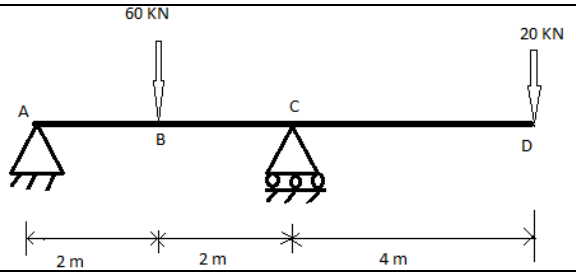
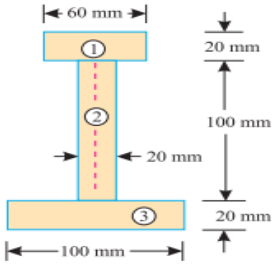
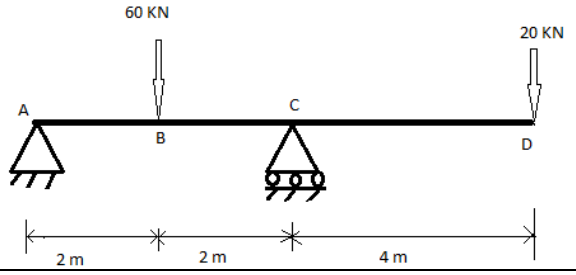
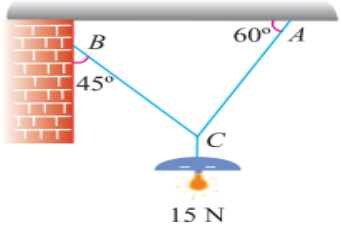
ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

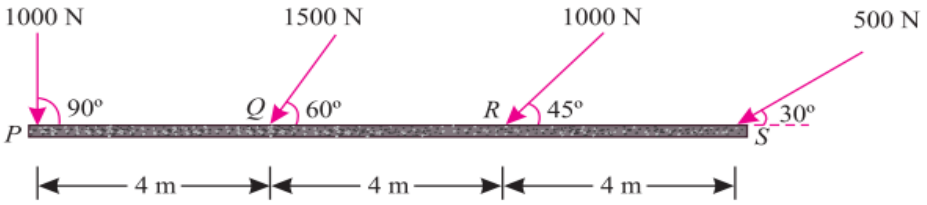
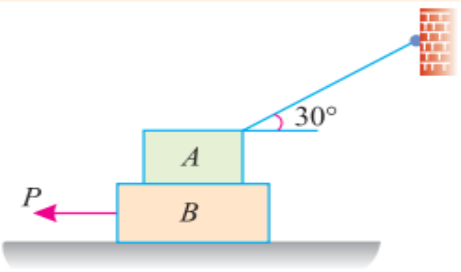
Name of the Program: B.Tech — Semester: II
Stream: CE/ME/EE/CSE/ECE
PAPER TITLE: Engineering Mechanics — PAPER CODE: MEE11002
Maximum Marks: 50 — Time duration: 3 hours
Total No of questions: 12 — Total No of Pages: 01

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (Answer All the Questions) (5 x 1 = 5)		
1.	**Explain** the Parallelogram Law of forces.	**U**	**CO1**
2.	**Explain**: Varignon's principle of moments	**U**	**CO1**
3.	 Compute the moment of inertia of the above area about axis K-K.	**R**	**CO2**
4.	**Find** the centroid of an unequal angle section 100 mm × 80 mm × 20 mm. 	**R**	**CO2**
5.	**What** is friction?	**U**	**CO3**
	SECTION B (Attempt any **Three Questions) (3 x 5 = 15)**		
4.	a) **Explain** principle of transmissibility? (b) **Find** out the reaction forces at support as shown in figure below using principle of virtual work.	**U**	**CO1**

			
5.	(a) **Estimate** the moment of inertia of perpendicular axis theorem (b) An I-section is made up of three rectangles as shown in Figure below. **Find** the moment of inertia of the section about the horizontal axis through the CG and parallel to the X-X axis. 	**Ap**	**CO2**
6.	(a) **Explain** Laws of friction? (b) An effort of 200 N is required just to move a certain body up an inclined plane of angle 15° with the force acting parallel to the plane. If the angle of inclination of the plane is made 20° the effort required, again applied parallel to the plane, is found to be 230 N. **Find** the weight of the body and the coefficient of friction.	**Ap**	**CO3**
7.	a) **Explain** principle of transmissibility? (b)**Find** out the reaction forces at support as shown in figure below using principle of virtual work. 	**U**	**CO1 /CO4**
	SECTION C (Answer Any Two Questions) (2 x 15 = 30)		
8.	An electric light fixture weighting 15 N hangs from a point C, by two strings AC and BC. The string AC is inclined at 60° to the horizontal and BC at 45° to the horizontal as shown in Figure. Using Lami's theorem, **determine** the forces in the strings AC and BC. 	**U**	**CO1**
9.	A horizontal line PQRS is 12 m long, where PQ = QR = RS = 4 m. Forces of 1000 N, 1500 N, 1000 N and 500 N act at P, Q, R and S respectively with downward direction. The lines of action of these forces make angles of 90°, 60°, 45° and 30° respectively with PS. **Find** the magnitude, direction and position of the resultant force	**U**	**CO1**

			
10.	Two blocks A and B of weights 1 kN and 2 kN respectively are in equilibrium position as shown in Figure 1. If the coefficient of friction between the two blocks as well as the block B and the floor is 0.3,**find** the force 'P' required to move the block  B.	**An**	**CO3**

Course code: EVS11112	Course Name: Environmental Science	L	T	P	C
Version 1.1	Contact Hours – 30	2	0	0	2
Pre-requisites/Exposure	Basic physics, chemistry, mathematics of +2 level.				
Co-requisites	--				

Course Objectives

1. To understand the intrinsic relation between humans and the environment, our position in the ecosystem around us
2. To comprehend the significance of the biodiversity surrounding us.
3. To figure out the importance and need for energy resources, various sources of energy, renewable and non-renewable sources, conventional and unconventional sources.
4. To have basic concepts about sustainability, our dependence on nature, and the consequences of overexploitation.
5. To enable students to appreciate the importance and how much we owe to the earth systems for our survival.
6. To have a basic concept about the types of pollution and mitigation procedures.
7. To have an overall idea about the environmental legal framework in our country and about the EIA and environmental audit procedures.

Course Outcomes:

On completion of this course, the students will be able to

CO1. Compare between various types of ecosystems, ecosystem dynamics, perceive and appreciate the surrounding nature

CO2. Perceive the intrinsic relation between humans and the environment, our position in the ecosystem around us, and the importance of biodiversity

CO3. Identify the presence of various pollutants, their significance, and impacts, and develop the underlying concepts involved in various air pollution prevention and mitigation measures.

CO4. Estimate the importance of natural resources including energy resources

CO5. Relate to the legal framework in our country for safeguarding the environment including pollution prevention, control, management, and wildlife management

Course Description

To distinguish between various types of ecosystems, ecosystem dynamics, perceive and appreciate the surrounding nature and feel connected, develop the concept of the innate relationship of humans and biodiversity, need for conservation, and different conservation strategies. The students will be developed in a way so that they can spontaneously comprehend the importance of studying the various air pollutants, their significance, and impacts, and develop the underlying concepts involved in various air pollution prevention and mitigation measures, understand fundamental water chemistry, deduce the relationship between various water pollutants, and understand the principles of various water and wastewater treatment procedures. They will understand the routes of generation, classification, management, and environmental significance of solid waste, apply the basic concepts of waste management in their daily lives, understand the need of the 5Rs of waste management, the importance of waste minimization.

Detailed syllabus

Unit I: Resources

Multidisciplinary nature of environmental sciences; scope and importance; need for public awareness; concept of sustainability and sustainable development

Forest resources: Function of forests, cause and effects of deforestation, case studies.

Water resources: distribution of water, hydrological cycle, use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies
Food Resources: World food problems and environmental concern, Food security, case studies
Energy resources: Concept of energy, SI Units of Work, Heat and Power, World energy use, Energy consumption pattern in India and U.S., Environmental aspects of energy utilization Renewable and non-renewable sources; Fossil fuel: types, use and environmental impacts, Solar energy: Solar Radiation – Passive and active solar systems – Flat Plate and Concentrating Collectors – Solar direct Thermal Application– Fundamentals of Solar Photo Voltaic Conversion- advantages and disadvantages of Solar Power generation, Solar energy status in India; Wind Energy: site selection, Wind turbine: basic working principle and types, Wind energy status in India, advantages and disadvantages of Wind Power generation; Hydroelectric power : How is it generated, advantages and disadvantages; Biomass energy: various types, generations of biofuel, Biogas plants, Bio diesel; Geothermal Energy: source, advantages and disadvantages, Nuclear Power: nuclear fission, moderation of reaction, nuclear reactor: pressurized water reactor, advantages and disadvantages

Unit II: Ecosystems and Biodiversity and its conservation
Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Food chains, food webs and ecological pyramids, energy flow, ecological succession, Levels of Biodiversity: genetic, species and ecosystem diversity. Biogeographical classification of India, Values of biodiversity, Biodiversity at global, National and local levels, India as a mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity, In-situ and Ex-situ conservation of Biodiversity

Unit III: Environmental Pollution and Waste Management
Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, marine pollution; case studies. Nuclear hazards and human health risks.
Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes, Recycling of waste material. Waste minimization technologies.

Unit IV: Global Issues and Environmental Acts if India
Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, habitat loss, Holocene Extinction.
International agreements on Environmental conservation and pollution prevention.
Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. Waste Management Rules, 2016 and other important acts.

Text Books:

1. Principles of Environmental Science, 4th edition by Cunningham, W.P. and Cunningham, M.A. (2002), Tata McGraw-Hill Publishing Company, New Delhi

2. Basic Environmental Engineering & Elementary Biology by Monidranath Patra and Rahul Kumar Singha, Aryan Publishing house

3. Introduction to Environmental Engineering and Science, by Masters, G.M., Prentice Hall of India, Second Indian Reprint.

Reference Books:

1 Wastewater Engineering: Treatment and Reuse, 4th Edition, Metcalf and Eddy, Inc. McGraw-Hill, Inc., New York, 2002

2 Environmental Engineering", Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, McGraw-Hill Education (India) Private Limited, New Delhi

3 Introduction to Environmental Engineering, 2nd Ed. by Davis, M. L. and Cornwell D. A. McGraw Hill, Singapore.

4 Environmental Sciences: The Environment and Human Impact by Jackson, A.R.W. and Jackson, J.M., Longman Publishers

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs):

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Compare between various types of ecosystems, ecosystem dynamics, perceive and appreciate the surrounding nature.	**PO2, PO5**
CO2	Perceive the intrinsic relation between humans and environment, our position in the ecosystem around us, and importance of biodiversity.	**PO2, PO5, PO6**
CO3	Identify the presence of various pollutants, their significance, and impacts, and develop the underlying concepts involved in various pollution prevention and mitigation measures.	**PO2, PSO7**
CO4	Estimate the importance of natural resources including energy resource.	**PO2, PO5, PO6**
CO5	Relate to the legal framework in our country for safeguarding the environment including pollution prevention, control, management, and wildlife management.	**PO2, PO5, PO6**

		Chemistry Knowledge: To understand basic facts and concepts in Chemistry while retaining the exciting aspects of Chemistry so as to develop an interest in the study of chemistry as a discipline.	**The Chemist and society:** To appreciate the achievements in Chemistry and to know the role of Chemistry in nature and in society.	**Computer usage in Chemistry:** To design and apply appropriate experiment techniques along with IT tools to solve chemical problems. Attain familiarity with the applications of computers in	**Practical Skills:** To develop skills in the proper handling of apparatus and chemicals.	**Analytical Skills:** To be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.	**Professional growth:** The students after completing the postgraduate course would have equipped their ability in the field of chemical analysis by their exposure to the sophisticated analytical	**Effective Communication:** Students will be able tocommunicate efficiently through project report writing, documentation and effective presentations.	**Skill Enhancement:** The postgraduate programme in Chemistry will enhance soft skills among students which is essential for future employability through activities such as seminar,	Postgraduate will encompass noteworthy opportunities in various service domains both at national and international level, and can work as scientist, analyst at testing facilities/labs, quality controller	To cultivate in –depth knowledge in Organic chemistry, Inorganic chemistry, Physical chemistry, Analytical chemistry, Spectroscopy, Pharmaceutical technique etc.	Students will acquire deep knowledge in the study of physical, chemical, electrochemical and magnetic properties, structure elucidation using various sophisticated techniques and their	Students will imbibe research acumen and inculcate innovative thinking so as to become a good researcher/academician as well as will perk up analytical and logical capability so as to import the	Postgraduate students will be able to communicate effectively the scientific information and research results in written and oral formats, to both professional scientists and to the public.	Postgraduate students will attain leadership quality to handle all kind of circumstances in diversities by providing interdisciplinary and multidisciplinary learning environment with team work	Students will evolve the culture of continuous learning to learn and adopt new skills and techniques for making of good society.
Course Code	Course Title	PO1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO8	PS O 1	PSO 2	PS O 3	PSO 4	PSO 5	PS O 6	PS O 7
SGY 5111 1	Environ mental Science	-	2	-	-	2	2	-	-	2	-	1	1	-	-	1

1=weakly mapped; 2= moderately mapped; 3=strongly mapped

EIC11001	Venture Ideation	L	T	P	C
Version 2.0	Contact Hours – 30	2	0	0	2
Pre-requisites/Exposure	Basic knowledge of English and computer applications such as Internet Explorer and MS Office				
Co-requisites	--				

Course Objectives

1. To help the students understand the way to be an Entrepreneur
2. To identify the right business opportunity
3. To empower students to perform a technical feasibility study and thereby developing a prototype
4. To help students in identifying their customers using primary and secondary research methods.
5. Expose students to various factors of market and competition with the help of market feasibility study, forecasting techniques, business model canvass and insights about financial statements.
6. To prepare students with finalizing their entrepreneurial Portfolio

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Assess** personal capacity in the context of the entrepreneurial process
CO2. **Assess** characteristics of successful entrepreneurs and entrepreneurial forms and processes
CO3. **Apply** resources, research and tools for Entrepreneurial ventures
CO4. **Analyze** and apply opportunity identification techniques, feasibility terminology, processes and models
CO5. **Develop** Ideation and planning documents for entrepreneurial venture

Course Description

Over the last decade, the core of our economy has been transitioning from one of industrial might, large monolithic corporations and mass production towards one of networks, flexible enterprises comprising many smaller units and unique value. This new economy is based on innovation originating in creativity and design; it is also disrupting long-standing and established employment patterns and bringing to the fore the importance of entrepreneurship. This core unit will bring together creativity, design and entrepreneurship at the conceptual and more practical level. It aims to explore the nature, determinants and consequences of creativity, design and entrepreneurship as well as the interaction between them.

Course Content

Module-I:
Introduction to Innovation and Entrepreneurial Idea Generation and Identifying Business Opportunities. Development of an Innovative Business Idea into a Proof-of-Concept.

Module-II:
Management Skills for Entrepreneurs and Managing for Value Creation. Development of Business Idea into working Prototype.

Module-III:
Creating and Sustaining Enterprising Model & Organizational. Development of Minimum Viable Business Model of Innovation.

Module-IV:
Advancing Entrepreneurial Skill and Venture Planning. Creating and Growing New Venture and National & Global Business Environment.

Module-V:
Action Learning Segment-I: Start-up/Incubation Residency Learning Program

References:

1. **LinkedIn learning**
2. **Different blogs**
3. **Google Scholar**

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Components	Mid Term	Class Assessment	End Term
Weightage (%)	**20**	**30**	**50**

Relationship between the Program Outcomes (POs), Program Specific Outcomes (PSOs) and Course Outcomes (COs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Assess** personal capacity in the context of the entrepreneurial process	**PO6, PO11**
CO2	**Assess** characteristics of successful entrepreneurs and entrepreneurial forms and processes	**PO6, PO11**
CO3	**Apply** resources, research and tools for Entrepreneurial ventures	**PO6, PO8, PO11**
CO4	**Analyze** and apply opportunity identification techniques, feasibility terminology, processes and models	**PO6, PO8, PO11**
CO5	**Develop** Ideation and planning documents for entrepreneurial venture	**PO6, PO8, PO11**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EIC11001	Venture Ideation						3		3			3			

1=Weakly mapped
2= Moderately mapped
3=Strongly mapped

GEE12002	Electrical and Electronics Technology Lab	L	T	P	C
Version 1.0	**Contact Hours – 45**	0	0	3	2
Pre-requisites/Exposure	Class 12th Level physics				
Co-requisites					

Course Objectives

1. To study basic electronic components
2. To observe characteristics of electronic devices
3. To study basic electrical circuits

Course Outcomes

On completion of this course, the students will be able to
CO1**. Illustrate** different meters and instruments for measurement of electronic quantities and understand network theorems.
CO2. **Show** the characteristics of different semiconductor devices like diode, BJT, FET etc and carbon tungsten filament lamps experimentally.
CO3. **Design** and experiment with various application circuits using diodes
CO4. **Design** R-L-C circuits
CO5. **Construct** three phase circuits

Course Description

Present technology requires necessary knowledge of ELECTRONICS in most fields. Avionics, Autotronics, Agrotronics, Physics, Process Chemistry, Health Services, etc., already employ components or even whole systems based on Electronics. Thus, there is an increasing number of professionals in these and many other fields who need adequate knowledge and training. Taken this into account, ADAMAS has developed the Basic Electronics and Electricity Integrated Laboratory, capable of covering different levels of difficulty. It is based on a series of self-taught modules, each one referring to a specific area of Electronics.

Course Content

List of experiments (Electrical Part):

1. Verification of Thevenin's theorem and Norton's theorem.
2. Verification of Superposition theorem.
3. Verification of Maximum power transfer theorem.
4. Study of R-L-C series circuit.
5. Study of R-L-C parallel circuit.
6. Performance study of fluorescent, LED, tungsten and carbon lamps.
7. Measurement of power in a three-phase circuit using two-wattmeter method.

List of experiments (Electronics Part):

1. Familiarization of bread board and electronics elements such as R, L, C, diode, and BJT etc.
2. Familiarization of Function generator and measuring instruments such as CRO and multimeter.
3. Study the V-I characteristic of PN junction diode and find knee voltage.
4. Study the input and output characteristic of bipolar junction transistor (BJT): Common emitter (CE) configuration.
5. Study the transfer and drain characteristic of junction field-effect transistor (JFET), hence determine the drain resistance, transconductance factor, amplification factor.
6. Study the transfer and drain characteristic of MOSFET, hence determine the drain resistance, transconductance factor, amplification factor.
7. Realization of digital logic circuit using MOSFET (AND, OR, NOT etc.).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and Pos		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Illustrate** different meters and instruments for measurement of electronic quantities and understand network theorems.	**PO1**
CO2	**Show** the characteristics of different semiconductor devices like diode, BJT, FET etc and carbon tungsten filament lamps experimentally.	**PO3**
CO3	**Design** and experiment with various application circuits using diodes.	**PO3**
CO4	**Design** R-L-C circuits	**PO1**
CO5	**Construct** three phase circuits	**PO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO 1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
GEE12002	Electrical and Elecronics Technology Lab	3		2											

1=weakly mapped
2= moderately mapped
3=strongly mapped

Name: **Enrolment No:**			
Course: GEE12002 – Electrical & Electronics Technology Lab **Program: B.Tech.** **Semester: ODD 2020-21** **Time: 03 hrs.** **Max. Marks: 50**			
SAMPLE QUESTIONS			
1.	**A)** Draw the forward V-I Characteristic curve of p-n junction diode with proper circuit connection and also **find** out the knee voltage. **B) Explain** the mechanism of drift & diffusion of carriers.	**U** **R**	**CO3**
2.	**A)** Draw and **compare** the input characteristics of BJT with proper circuit connection (in common emitter configuration) with three different V_{CE} values. **B) What** are the differences between BJT & FET? Explain thermal runway	**U** **R**	**CO2**
3.	**A)** Draw and **compare** the output characteristics of BJT with proper circuit connection (in common emitter configuration) with three different I_B values. **B) What** do you mean by pinch-off voltage? Derive the relationship between α, β and γ.	**U** **R**	**CO2**
4.	**A)** Draw and **compare** the drain characteristics of FET with proper circuit connection with three different V_{GS} values (0v, -1v & -2v). **B) Define** the following terms of a FET with mathematical expressions: **i)** Trans conductance (g_m), **ii)** Drain resistance (r_d).	**U** **R**	**CO2**
5.	**A) i) Estimate** the various resistance values using colour code and compare with measured values. **ii) Measure** the forward & reverse resistance of various diodes. **iii) Identify** the pnp & npn transistors and find out the different terminals. **B) What** are the differences between intrinsic and extrinsic semiconductor? Write approximate value of cut-in voltage for Si and Ge diode.	**Ap** **U**	**CO1**
6.	**A) Show** the different signals (Sine, Square & Triangle) using function generator and measure the amplitude and frequency of each signal.	**U**	**CO2**

	B) Draw and **explain** the common emitter transistor circuit and output characteristics.		
7.	**A) Show** Thevenin's, Norton's, Superposition and Maximum power transfer theorem. **B) What** is load matching? **C)** To **what** type of circuit Thevenin's theorem is applicable? **D) What** is the use of Thevenin's theorem?	**Ap** **R** **R**	**CO1**
8.	**A) Estimate** the resistance, inductance and capacitance for series and parallel RLC circuit using ammeter and voltmeter reading. **B) Measure** power factor for RLC series circuit.	**Ap** **Ap**	**CO4**
9.	**A) What** is the nature (i.e. positive or negative) of the slop of the voltage vs. Resistance characteristics of Tungsten Filament Lamp? **Explain** it briefly. **B) What** is the function of starter? What is the function of choke?	**R**	**CO2**
10.	**A) How** many coils are there in a single in a single phase wattmeter? **B) Which** type of wattmeter is generally used for measuring power in a.c. circuits? **C) What** do you understand by phase sequence in reference to 3-phase circuits? **D)** In a star connected 3-phase balanced load with neutral available, **how** many wattmeters are necessary to measure power?	**R**	**CO5**

MEE12001	Engineering Workshop	L	T	P	C
Version 1.0	Contact Hours – 45	0	0	3	2
Pre-requisites/Exposure	12th level Physics, Engineering Mechanics				
Co-requisites	--				

Course Objectives:

1. To develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude.
2. To acquire skills in basic engineering practice
3. To identify the hand tools and instruments
4. To gain measuring skills
5. To develop general machining skills in the students

Course Outcomes:

On completion of this course, the students will be able to

CO1 **Demonstrate** the basic operations in pattern and mould making
CO2 **Analyze** different metal fitting works
CO3 **Find** the basic forging and welding works
CO4 **Illustrate** the operations of machine tools
CO5 **Select** the appropriate tools required for specific operation
CO6 **Determine** the safety measures required to be taken while using the tools

Course Description:

Engineering Workshop is a place where students acquire knowledge on the operation of various processes involved in manufacturing and production. The Workshop Practice course makes students competent in handling practical work in engineering environment. Students will be expected to be familiar with engineering problems related to practical field.

Course Content

List of Experiments (Any ten)	
1	To make a single piece pattern from the given work piece and dimensions.
2	To make a double piece match pattern from the given dimensions.
3	To make a single piece cylindrical (solid) pattern from the given dimensions.
4	To make a cone from sheet metal as per given dimensions.
5	To make a frustum from sheet metal as per given dimensions.
6	To prepare a sand mold, given the single piece pattern and casting.
7	To prepare a sand mold, given the double piece match pattern and casting with different dimensions and shape
8	To make a square fitting from the given mild steel piece and the dimensions.
9	To make a square fitting from the given mild steel piece and the dimensions.
10	To make a single 'V' butt joint between two metal plates by using ARC welding.
11	To make a square butt joint between metal plates by using gas welding.

12	To perform various types of machining operations (cantering, facing and turning) on a given mild steel rod followed by the given dimensions.
13	To perform various types of machining operations (chamfering, grooving, thread cutting, and knurling) on a given mild steel rod followed by the given dimensions.

Reference Books

1. Workshop Technology by S.K. Garg, 3rd Edition, LP

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Demonstrate** the basic operations in pattern and mold making	**PO1,PO9 PSO1**
CO2	**Analyze** different metal fitting works	**PO1, PO9, PSO1**
CO3	**Find** the basic forging and welding works	**PO1, PO9, PSO1**
CO4	**Illustrate** the operations of machine tools	**PO1, PO9, PSO1**
CO5	**Select** the appropriate tools required for specific operation	**PO1, PO9, PSO1**
CO6	**Determine** the safety measures required to be taken while using the tools	**PO1, PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
MEE12001	Engineering Workshop	3								3				3	

1=weakly mapped,
2= moderately mapped,
3=strongly mapped

Model Question Paper

ADAMAS UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
END-SEMESTER EXAMINATION: JULY 2020

Name of the Program: B. Tech
Stream: CE/ME/CSE/ECE/EE
Semester: II/I

PAPER TITLE: Engineering Workshop
PAPER CODE: MEE12001
Maximum Marks: 50
Time duration: 3 hours
Total No of questions: 12
Total No of Pages: 01

Instruction for the Candidate:

1. At top sheet, clearly mention Name, Univ. Roll No., Enrolment No., Paper Name & Code, Date of Exam.
2. All parts of a Question should be answered consecutively. Each Answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

	Section A (Answer All the Questions) (5 x 1 = 5)		
1.	**Explain** advantages and limitations of Gas welding.	**U**	**CO3**
2.	**Design** the steps involved in making a mold	**U**	**CO1**
3.	**Show** the various types of pattern with neat sketch.	**R**	**CO1**
4.	**Show** the specification of lathe machine.	**R**	**CO4**
5.	**Explain** limitations of Gas welding.	**U**	**CO3**
	SECTION B (Attempt any **Three Questions) (3 x 5 = 15)**		
4.	**Show** the function of main parts of lathe machine. List some of the operation that can be done on the lathe machine and perform any one operation in lathe machine	**U**	**CO4**
5.	To **design** a single piece cylindrical (solid) pattern from the given dimensions.	**Ap**	**CO1**
6.	To **design** a square fitting from the given mild steel piece and the dimensions.	**Ap**	**CO2**
7.	**Discuss** about Turning, Facing, Runner.	**U**	**CO4 /CO5**
	SECTION (Answer Any Two Questions) (2 x 10 = 20)		
8.	To **design** a single 'V' butt joint between two metal plates by using ARC welding.	**U**	**CO3**
9.	**Show** the various types of allowance in molding operation.	**U**	**CO1**

SECOND YEAR
SEMESTER III

MTH11535	Engineering Mathematics – III B	L	T	P	C
Version 1.0	**Contact Hours – 60**	3	1	0	4
Pre-requisites/Exposure	12^{th} level Mathematics and Engineering Mathematics- I &II				
Co-requisites	--				

Couse Objective

1. To understand the fundamental of Laplace, transform and its properties.
2. To develop the concept to solve engineering problems using Laplace transform.
3. To give the basic idea of z-transform and its engineering applications.
4. To empower students to acquire knowledge of some special function such as Hermite, Laguerre and Legendre functions and its importance in engineering sciences.

Couse Outcome

On completion of this course, the students will be able to

CO1. Acquire the fundamental concept of Laplace transform and its properties.
CO2. Acquire the fundamental concept of inverse Laplace transform and its properties.
CO3. Develop knowledge to apply Laplace transform technique in real life problems.
CO4. Acquire the basic idea of z-transform and its engineering applications.
CO5. Understand the concept of Special functions and their importance in engineering sciences.

Course Description

Transform Calculus and Special Functions is an integral part of engineering science. The topics covered in this course is very much important for core paper in engineering like digital signal processing, image processing, coding theory etc. Classroom activities will be designed to encourage students to play an active role in the construction of their own knowledge and in the design of their own learning strategies. We will combine traditional lectures with other active teaching methodologies, such as cooperative group solving problems, assignments, topic for power point presentation group wise. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities and to give an oral group presentation.

Course Content

Unit I: **15 lecture hours**

Laplace Transform: Definition, Linearity, shifting & scaling properties, Transform of elementary functions, Transform of derivatives and integrals, Multiplication by *t*& division by *t*. Inverse Laplace transform, Convolution theorem, Transform of periodic functions, Unit step function & Dirac delta function, Initial value & final value theorems and its application to

solution of ordinary differential equations and partial differential equations such as heat conduction, wave equation and Laplace equation.

Unit II: **15 lecture hours**

Z – Transform: Sequence, Basic operations on sequences, Definition of z-Transform, Linearity, Change of scale & shifting properties, z-transform of standard sequences, Inverse z-Transform, Multiplication by *n*& division by *n*, Initial value & final value theorems, Convolution of sequences, Convolution theorem, Inverse z- transform by partial fraction, power series and residue methods and its application to solution of difference equations.

Unit III: **15 lecture hours**

Special Functions: Moment, functionals and orthogonality, Existence of orthogonal polynomial systems, The fundamental recurrence formula, Zeros of orthogonal polynomials, Hermite Polynomial, Laguerre Polynomial, Legendre Polynomial.

Text Books

1. B.V.Ramana, *Higher Engineering Mathematics*, McGraw Hill Education, 2017.
2. H. K.Das,*Advanced Engineering Mathematics*, S Chand, 2007.

Reference Books

1. C. B. Gupta, S. R. Singh and Mukesh Kumar, *Engineering Mathematics for Semesters I and II*, McGraw Hill Education, 2017.
2. C. B. Gupta, S. R. Singh and Mukesh Kumar, Engineering Mathematics for Semesters III and IV, McGraw Hill Education, 2017.
3. T.S. Chihara, An introduction to orthogonal polynomials, Dover Publications Inc., 2011.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Acquire** the fundamental concept of Laplace transform and its properties.	**PO2, PO3, PO4, PO12**
CO2	**Acquire** the fundamental concept of inverse Laplace transform and its properties	**PO2, PO3, PO4, PO12**
CO3	**Develop** knowledge to apply Laplace transform technique in real life problems.	**PO2, PO3, PO4, PO12**
CO4	**Acquire** the basic idea of z-transform and its engineering applications.	**PO2, PO3, PO4, PO12**
CO5	**Understand** the concept of Special functions and their importance in engineering sciences	**PO2, PO3, PO4, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
MTH11526	Engineering Mathematics-III		3	3	3								3			

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12004	MATLAB & Simulink Lab	L	T	P	C
Version 1.0	**Contact Hours - 45**	0	0	3	2
Pre-requisites/Exposure	1. 12th level Mathematics 2. Knowledge of computer				
Co-requisites					

Course Objective

1. To provide background and fundamentals of MATLAB tool for the analysis and processing of signals and to generate various continuous and discrete time signals.

2. To provide an overview of signal transmission through linear systems, convolution and correlation of signals and sampling.

3. To understand the concept and importance of Fourier and Z-Transforms

4. To introduce Digital logic design software for constructing various types of Digital circuit used in real time application.

Course Outcome

1. Analyze the generation Various Signals and Sequences in MATLAB, including the operations on Signals and Sequences.

2. Verification of Sampling Theorem, Linearity and Time Invariance Properties of a given Signals/ Systems.

3. Analyze the Fourier Transform of a given signal and plotting its magnitude and phase spectrum and also plot Pole-Zero Maps in Z-Plane.

4. Analyze and **design** various signal analysis concepts.

5. Analyze and **design** various biomedical signal processing programs.

Course Description

This is a laboratory in which students are required to show their innovativeness and understanding of the subject through software based programming. This laboratory course builds on the lecture course "Signals and systems" and “Signal Processing & control systems”

Course Content

List of Experiments:

1. Familiarization with MATLAB, Simulink tool box and m-file.
2. Determination of overall transfer function from the block diagram of a system.

3. Determination of impulse response and step response of 1st order and 2nd order systems. From the step response of a 2nd order system, determine time-domain specifications like rise time, peak time, settling time, peak overshoot etc. with/without MATLAB.
4. Determination of steady state errors of Type-0, Type-1 and Type-2 systems for step, ramp and parabolic inputs using MATLAB.
5. Determination of Root Locus of different types of systems using MATLAB, and their time domain specifications with/without MATLAB.
6. To plot root locus diagram of an open loop transfer function and determine range of gain K for stability.
7. Determination of Bode plot for different systems using MATLAB, and their frequency domain specifications with/without MATLAB.
8. Determination of Nyquist plot for different systems using MATLAB, and their frequency domain specifications with/without MATLAB.
9. To draw a Nyquist plot of an open loop transfer functions and examines the stability of the closed loop system.
10. Determinations of approximate transfer function from Bode plot

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Class Assessment**	**End Term**
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Analyze** the generation Various Signals and Sequences in MATLAB, including the operations on Signals and Sequences.	**PO2, PO4, PO5, PSO1, PSO3**
CO2	**2. Verification** of Sampling Theorem, Linearity and Time Invariance Properties of a given Signals/ Systems.	**PO2, PO4, PO5, PSO1, PSO3**
CO3	**Analyze** the Fourier Transform of a given signal and plotting its magnitude and phase spectrum and also plot Pole-Zero Maps in Z-Plane.	**PO2, PO4, PO5, PSO1, PSO3**
CO4	**Analyze** and **design** various signal analysis concepts.	**PO2, PO4, PO5, PSO1, PSO3**
CO5	**Analyze** and **design** various biomedical signal processing programs.	**PO2, PO4, PO5,**

		PSO1, PSO3

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11004	MATLAB & Simulink Lab		3		3	3								3		3

1 = weakly mapped

2 = moderately mapped

3 = strongly mapped

BME11001	Prof. Core- I (Analog and Digital Electronics)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	1. **Circuit Theory:** Kirchhoff's current law, Kirchhoff's voltage law, Two port network 2. **Basic Electronics:** Semiconductor Device				
Co-requisites					

Course Objectives

1. To introduce components such as diodes, BJTs and FETs.
2. To give Understand of various types of amplifier circuits.
3. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
4. To understand the concepts of combinational logic circuits and sequential circuits.

Course Outcomes

On completion of this course, the student will be able to:

CO1. Know the characteristics of various electronic components.
CO2. Design and analyze small signal amplifier circuits.
CO3. Learn Postulates of Boolean algebra and minimize combinational functions.
CO4. Design and analyze combinational and sequential circuits.
CO5. Know about the logic families and realization of logic gates.

Course Description

The course has been designed to introduce fundamental principles of analog and digital electronics. The students completing this course will understand basic analog and digital electronics, including semiconductor properties, operational amplifiers, combinational and sequential logic, and analog-to-digital digital-to-analog conversion techniques. Finally, students will gain experience in the design of analog amplifiers, power supplies, and logic devices.

All the lectures will be devoted to discussions of basic theories and advanced topics, focusing on the practical implementation of knowledge. Classes will be conducted by lecture as well as PowerPoint presentation and audiovisual virtual lab session as per requirement. The tutorials will familiarize the student with practical problem-solving techniques led by the course coordinator. The student will strongly grab the basic concepts of the subject via exercise and discussions with the coordinator.

Course Content

Module 1: Biasing of BJT:

BJT characteristics & parameters, all biasing circuits, analysis of above circuits and their design,variation of operation point and its stability. Introduction to FET and comparison with BJT.

[8L]

Module 2: Operational Amplifiers and Linear Applications:

Block diagram representation, ideal op-amp, equivalent circuit, open-loop configuration, transfer characteristics, op-amp with negative feedback, frequency response op-amp IC741 specifications, basic op-amp applications: adder, scalar, subtractor, difference amplifier, I-V converter, V-I converters, integrator, differentiator, instrumentation amplifier using 2 and 3 op-amp stages. IC555 timer, multivibrators: astable, monostable and bistable.

[10L]

Module 3: Number Systems and Codes: Binary, octal, decimal and hexadecimal number systemsand their conversion, binary addition and subtraction.

[4L]

Module 4: Boolean Algebra and Logic Gates: Theorems and properties of Boolean algebra, standard SOP and POS form, reduction of Boolean functions using algebric method, K-map method (2,3,4 Variable), basic digital circuits: NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR gates.

[8L]

Module 5: Combinational Logic Design: Introduction, half and full adder, half and full subtractor, four bit binary adder, one digit BCD adder, code conversion, multiplexers and demultiplexers, decoders, 4-bit magnitude comparator.

[8L]

Module 6: Sequential Logic Design: Flip Flops: SR, D, JK, JK Master Slave and T Flip Flop, truth tables and excitation tables, Flip-flop conversion,counters: design of asynchronous and synchronous counters, modulo counters, UP-DOWN counter, IC74193 shift registers: shift registerIC7496, SISO, SIPO,PIPO,PISO, bidirectional shift register. **[6L]**

Text Books:	
1	Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson, 2013.
2	Ramakant A. Gayakwad, Op-amps and Linear Integrated Circuits, Pearson Education, 2015.
Reference Books:	
1	R. P. Jain, Modern Digital Electronics, 4th Ed., McGraw Hill Education, 2009.
2	M. Morris Mano, Digital Logic and Computer Design, Pearson Education, 2004
3	Martin Roden, Gordon Carpenter and William Wieserman, Electronic Design: From Concept to Reality, 4th Ed., Discovery Press, 2002.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Know** the characteristics of various electronic components.	**PO2, PO4, PO5, PSO1, PSO3**
CO2	**Design** and analyze small signal amplifier circuits.	**PO2, PO4, PO5, PSO1, PSO3**
CO3	**Learn** Postulates of Boolean algebra and minimize combinational functions.	**PO2, PO4, PO5, PSO1, PSO3**
CO4	**Design** and analyze combinational and sequential circuits.	**PO2, PO4, PO5, PSO1, PSO3**
CO5	**Know** about the logic families and realization of logic gates.	**PO2, PO4, PO5, PSO1, PSO3**

Course Code	Course Title	Engineering Knowledge PO 1	Problem analysis PO 2	Design/development of solutions PO 3	Conduct investigations of complex problems PO 4	Modern tool usage PO 5	The engineer and society PO 6	Environment and sustainability PO 7	Ethics PO 8	Individual or team work PO 9	Communication PO 10	Project management and finance PO 11	Life-long Learning PO 12	Understand the basic concepts of all the sub-domains of Biomedical Engineering. PS O1	Analyze the results and problems related to the health care sectors PS O2	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions PS O3
BME11001	Prof. Core- I (Analog and Digital Electronics)		3		3	3								3		3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11002	**Prof. Core- II (Anatomy & Physiology)**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Basic idea about basic life science				
Co-requisites	Class 12th level basic idea of Anatomy & Physiology				

Course Objectives

1. In-depth understanding of anatomy and physiology of the cardiovascular system, the pulmonary system, the renal system, the digestive system, the nervous system, the muscular system and the skeletal system.

2. Understand the corresponding structure function relationship of these physiological systems.
3. Make measurements on and interpret data of physiological processes in living systems.
4. Explain mechanisms of communication, integration and homeostasis involved in physiological parameters and energy balance.
5. Understand and postulate physiological concepts based on anatomical information
6. Enable students to develop their critical reasoning skills in the field of Engineering Physiology & anatomy.

Course Outcomes

On completion of this course, the students will be able to

CO1. In-depth understanding of anatomy and physiology of heart and blood vessel, the lung, the renal system, the digestive system, the nervous system, the muscular system and the skeletal system extended up to tissue and organs

CO2. Understand and relate the corresponding structure function relationship of these physiological systems

CO3. Make measurements on and interpret data of physiological processes in living systems

CO4. Explain mechanisms of communication, integration and homeostasis involved in physiological parameters and energy balance

CO5. Enable students to understand and postulate physiological concepts based on anatomical information and develop their critical reasoning skills in the field of Engineering Physiology & anatomy

Course Description

The course has been designed to introduce fundamental principles of anatomy and physiology. The students completing this course will understand understanding of anatomy and physiology of the cardiovascular system, the pulmonary system, the renal system, the digestive system, the nervous system, the muscular system and the skeletal system. Finally, students will gain experience in their critical reasoning skills in the field of Engineering Physiology & anatomy

Course Content

Module 1: Organization of Human Body: Anatomical position, terminology, regions and planes. Basic anatomy and physiology of cells, Tissues (epithelial, connective, muscle, nervous, blood, glands), Permeability of cell membrane, genesis of membrane potential excitation of cell

Module 2: Skeletal System: Functions of skeletal system, Anatomy of long bone, Bonehistology, Naming all bones of axial and appendicular skeleton, Formation, growth and repair, Structural and functional classification of joints, Types of movement, Calcium homeostasis.

Module 3: Muscular System: Functions of muscular system, Names of all major muscles, Origin, insertion and action, Sliding Filament Model, Neuromuscular junction, Structure (gross and microscopic), Physiology of muscle contraction, Muscle metabolism (ATP), Fiber types, Exercise physiology.

Module 4: Cardiovascular System: Functions of circulatory system, Heart structures (chambers, valves, and vessels), Circulatory routes (systemic, pulmonary, coronary and hepatic portal), Blood vessels and pressure,Blood components, function and typing, Blood clotting, Regulation and conduction (EKG). Blood- composition, blood groups, role of R.B.C and W.B.C

Module 5: Lymphatic/Immune System: Functions of lymphatic system, Structures (vessels, nodes, cells), Lines of defense, Humoral immune response, Cell mediated immune response, Immune cell types.

Module 6: Digestive System: Functions of digestive organs, Modes of mechanical digestion, Chemical digestion (hormones, enzymes, pH), Absorption and elimination, Name parts of GI Tract and accessory organs, Nutrition and metabolism (production of ATP).

Module 7: Excretory System: Functions of urinary system, Kidney, ureter, bladder, urethra, Microanatomy and function of nephron, Formation of urine-steps involved.

Module 8: Respiratory System: General structure of respiratory system and functions- Lungs and Trachea, Respiratory Pathways, Functional aspects and mechanics of respiration, Mechanics and regulation of breathing, Gas exchange and gas laws, Hypoxia, effect of exercise.

Module 9: Nervous System: Functions of nervous system, Nerve cell anatomy, Neural physiology (action potential, synaptic transmission, Na/K pump), Brain anatomy and hemispheres, Spinal cord anatomy, reflex arc, PNS (autonomic and somatic), Sensory motor nerve functions.

Module 10: Endocrine System: Functions of endocrine system, Naming organs/glands/cells and their hormones, Hormone types and target cells, Chemical messengers.

Module 11: Reproductive System: Functions reproductive systems, Male and female anatomy, Menstrual cycle, Meiosis/gamete production.

Module 12: Sensory System: Basic anatomy of special senses: Eye, Ear, Tongue, Nose and Skin, Properties and functions of nervous system with respect to sensory organs.

Text Books:	
1	Charles E. Tobin, Basic Human Anatomy, McGraw HillPublication.
2	J. H. Green An Introduction to HumanPhysiology.

	H.B. Charles and B.N. Taylor; The Physiological Basis of Medical Practice. William and Wilkins, Baltimore,1985
Reference Books:	
1	C.A. Keele and Eric Neil; Samson Wright's Applied Physiology. ELBS, London,1984.
2	S. West, E.R. Todd, W.S. Mason and H.J.T. Van Bruggen; Text Book of Biochemistry. Macmillan Co.,1976.
3	A.G. Guyton; Textbook of Medical Physiology; Saunders, Philadelphia,1986.
4	Anatomy and Physiology in Health and Illness: Ross and Wilson (ELBSpub).
5	Human Physiology by A. Vander, J. Sherman and D. Luciano McGrawHill.
6	Principles of Anatomy and Physiology: Tortora and Grabowski. (Haper Collin pub.).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	In-depth understanding of anatomy and physiology of heart and blood vessel, the lung, the renal system, the digestive system, the nervous system, the muscular system and the skeletal system extended up to tissue and organs	**PO2, PO4, PO5, PSO1, PSO3**
CO2	Understand and relate the corresponding structure function relationship of these physiological systems	**PO2, PO4, PO5, PSO1, PSO3**
CO3	Make measurements on and interpret data of physiological processes in living systems	**PO2, PO4, PO5, PSO1, PSO3**
CO4	Explain mechanisms of communication, integration and homeostasis involved in physiological parameters and energy balance	**PO2, PO4, PO5, PSO1, PSO3**
CO5	Enable students to understand and postulate physiological concepts based on anatomical information and develop their critical reasoning skills in the field of Engineering Physiology & anatomy	**PO2, PO4, PO5, PSO1, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11002	Prof. Core- II (Anatomy & Physiology)		3		3	3								3		3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11003	Prof. Core- III (Signals and Network Analysis)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	1. 12th level Mathematics 2. Knowledge of 12th level Physics				
Co-requisites					

Course Objectives

1. To familiarize students with Resonance in Circuits and relevant parameters and methods for evaluating the same.
2. To introduce students the methods of Mesh Current and Node Voltage analysis and their application.
3. To describe Network Theorems and their applications.
4. To illustrate graph theory and its application in estimating electrical parameters in the circuit.
5. To introduce students with coupled circuits and their methods of analysis.
6. To introduce students with transient circuits and describe the methodology to evaluate relevant electrical parameters.
7. To highlight the application of Laplace & Inverse Laplace transform in analyzing circuits

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand, Describe, Analyze and Design series and parallel RLC circuits and solve related problems

CO2. Apply and Analyze Network Theorems to electrical networks to evaluate network parameters in simplified ways and analyze circuits using Node Voltage & Mesh Current Analysis in electrical networks and solve related problems.

CO3. Understand, Describe, Analyze and Design Graph and Trees for a given network and build network matrices and solve related problems

CO4. Understand Describe, Analyze and Design Coupled (Magnetic and Electromagnetic) Circuits and solve related problems

CO5. Understand, Describe and Analyze the Transients in electrical networks and solve related problems

Course Description

The course has been designed to introduce fundamental principles of Signals and Network Analysis. The main objective of learning this course on biomedical signals and systems for biomedical engineering students is to acquire knowledge for analyzing the continuous time discrete time signals & systems and its bio signal applications.

Course Content

Module 1: Introduction of signals and systems: signal and system types and classifications, basic Operations on signals, Parseval's theorem, step response, impulse response and convolution integral, concepts of correlation, power spectral density.

[06L]

Module 2: Periodic and aperiodic signal analysis: Periodic signal analysis: Fourier series and properties; Aperiodic signal analysis: Fourier Transform - its properties and sinusoidal steady state analysis of systems

[08L]

Module 3: Elements of electrical network and analysis: Dependent and independent sources, active and passive components; linear and nonlinear circuit, lateral and bilateral circuit, lumped and distributed circuit, Generalized formulation of KCL, KVL, State Variable descriptions; Thevenin, Norton, Maximum Power Transfer, Tellegen and Reciprocity Theorems; classical differential equations for description of transient conditions of Network; Solutions of linear time invariant networks with initial conditions; Unilateral and Bilateral Laplace Transforms and properties; Transient analysis of RL and RC circuits using Laplace Transform; Network functions: poles, zeros, transfer function.
[20L]

Module 4: Network Topology: Graph theory: Tree, Co-tree, fundamental cut-set, fundamental loopanalysis of network

[08L]

Module 5: One and two port network parameters and functions: Z, Y and ABCD, parameters, drivingpoint and transfer impedances and admittances.

[08L]

Module 6: Analog filter design: HP, LP, BP, BR Filter, Butterworth, Sallen Key,frequency transformationand scaling.

[10L]

Text Books:	
1	"Signals & Systems" by Oppenheim, Willsky and Nawab, Pearson, PHI
2	"Network Analysis" by M.E. Van Valkenburg, Third Edition; Prentice Hall, 1986.
	"Network Analysis & Synthesis" by F.F.Kuo; John Wiley & Sons Inc.
Reference Books:	
1	"Signals and systems", by A NagoorKani, Tata McGraw Hill, Indian Reprint, 2010
2	"Digital Signal Processing", by Proakis : Pearson
3	"Fundamental of electric circuit theory", by D. Chattopadhyay and P.C.Rakshit, S. Chand, 2009

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand**, Describe, Analyze and Design series and parallel RLC circuits and solve related problems	**PO2, PO4, PO5, PSO1, PSO3**
CO2	**Apply** and Analyze Network Theorems to electrical networks to evaluate network parameters in simplified ways.	**PO2, PO4, PO5, PSO1, PSO3**
CO3	**Analyze** circuits using Node Voltage & Mesh Current Analysis in electrical networks and solve related problems and Understand, Describe, Analyze and Design Graph and Trees for a given network and build network matrices and solve related problems	**PO2, PO4, PO5, PSO1, PSO3**
CO4	**Understand** Describe, Analyze and Design Coupled (Magnetic and Electromagnetic) Circuits and solve related problems	**PO2, PO4, PO5, PSO1, PSO3**
CO5	**Understand**, Describe and Analyze the Transients in electrical networks and solve related problems	**PO2, PO4, PO5, PSO1, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME11003	Prof. Core-III (Signals and Network Analysis)		3		3	3								3		3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12005	Prof. Core-I Lab (Signals and Network Analysis Lab)	L	T	P	C
Version 1.0	Contact Hours - 45	0	0	3	2
Pre-requisites/Exposure	1. 12th level Mathematics 2. Knowledge of 12th level Physics				
Co-requisites	--				

Course Objective

1. To familiarize students MATLAB Software and its application in circuit analysis.
2. To introduce students in evaluating electrical parameters in resonant circuits using MATLAB.
3. To implement MATLAB in verification of Network theorems.
4. To familiarize students in measuring electrical parameters in transient circuits using MATLAB.
5. To introduce students with the generation of various waveforms using MATLAB.
6. To apply MATAB in evaluating impedance and admittance parameters in a circuit.
7. To familiarize students with poles & zeros concepts and the techniques in evaluating the same.
8. To enumerate application of Laplace transform and its inverse in analysis of circuits.

Course Outcome

After completion of this course the students will be able to

CO1. Describe Analyze and Design series and parallel RLC circuits using MATLAB. Analyze circuits using Node Voltage & Mesh Current Analysis in electrical networks using MATLAB.

CO2. Verify and analyze Network Theorems to electrical networks using MATLAB.

CO3. Understand Describe, Analyze and Design Graph and Trees for a given network and solve related problems using MATLAB.

CO4. Understand Analyze and Design Coupled Circuits, the Transients in electrical networks and solve related problem using MATLAB.

CO5. Implement Laplace Transform and its Inverse transform on various waveforms using MATLAB

Course Description

The course has been designed to introduce fundamental principles of Signals and Network Analysis. The main objective of learning this course on biomedical signals and systems for biomedical engineering students is to acquire knowledge for analyzing the continuous time discrete time signals & systems and its bio signal applications.

Course Content

List of Experiments:

1. Familiarization with MATLAB

2. Generation of common Periodic (Sinusoidal, Square, sawtooth), common aperiodic (Gaussian Pulse, and Damped Sinusoidal Signal), impulse, Unit Step, ramp signal using MATLAB 3.Generation of Delayed Unit Step and Delayed Unit Impulse Signal.

4. Determination of Laplace Transform and Inverse Laplace transform of variables, functions.

5. Generate Transfer Function of 1st order and 2nd order system (including feedback) andcompute Poles and zeros of a given TF in S domain.

6. Perform Convolution and Deconvolution one sinusoidal with one unit step signal.

7. Determine the convolution of

i) Two vectors u = [1 2 3 4], v = [10 20 30], also recover vector v after deconvolving the result with u.

ii) A sinusoidal signal with a random noise.

8. Determination of impulse response of the system governed by the transfer function G(S) = 1/(s2+s+1) . Determine the step response of the circuit defined by an impulse response of h(t)=5e-t sin2t u(t).

9. Design an analog high pass Butterworth filter of the order 4th, with a Sampling frequency of1000 Hz, cutoff frequency of 300 Hz, which corresponds to a normalized value of 0.6.

10. Determine the h and ABCD parameters of a two port network.

11. Determine the Z parameters and Y of a two port network.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Describe** Analyze and Design series and parallel RLC circuits using MATLAB. Analyze circuits using Node Voltage & Mesh Current Analysis in electrical networks using MATLAB.	**PO2, PO4, PO5, PSO1, PSO3**
CO2	**Verify** and analyze Network Theorems to electrical networks using MATLAB.	**PO2, PO4, PO5, PSO1, PSO3**
CO3	**Understand** Describe, Analyze and Design Graph and Trees for a given network and solve related problems using MATLAB.	**PO2, PO4, PO5, PSO1, PSO3**
CO4	**Understand** Analyze and Design Coupled Circuits, the Transients in electrical networks and solve related problem using MATLAB	**PO2, PO4, PO5, PSO1, PSO3**
CO5	**Implement** Laplace Transform and its Inverse transform on various waveforms using MATLAB	**PO2, PO4, PO5, PSO1, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12005	Prof. Core-I Lab (Signals and Network Analysis Lab)		3		3	3								3		3

1 = weakly mapped,
2 = moderately mapped,
3 = strongly mapped

BME12006	Prof. Core-III Lab (Electronics Lab)	L	T	P	C
Version 1.0	Contact Hours - 45	0	0	3	2
Pre-requisites/Exposure	1. 12th level Mathematics 2. Knowledge of 12th level Physics				
Co-requisites					

Course Objective

1. To illustrate the students different electronic circuit and their application in practice.
2. To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive parameters.
3. To understand the principle of operation of different oscillators circuits.
4. To understand the design process of various basic linear application circuits using OP-AMP.
5. To understand and design circuits using 555 Timer.

Course Outcome

After completion of this course the students will be able to

CO1. **Identify** relevant information to supplement to the Analog Electronic Circuits course.

CO2. **Choose** testing strategies and select proper instruments to evaluate performance characteristics of electronic circuit.

CO3. **Construct** testing and experimental procedures on different types of electronic circuit and their operation in different operating conditions.

CO4. **Compare** possible causes of discrepancy in practical experimental observations to theory concepts.

CO5. **Explain** different types of wiring and instruments connections keeping in mind technical, Economical, safety issues

Course Description

In this course the working of various rectifier circuit is explained. In addition, students learn how various mathematical operations have done using OP-AMP (IC-741), different types of oscillators and their working and characteristics of various multi vibrator using IC 555 timer.

Course Content

List of Experiments:

1. Study the half wave rectifier circuit: find ripple factor and observe output waveformwithout and with RC filter circuit.
2. Study centre-tap full wave rectifier circuit: find ripple factor and observe outputwaveform without and with RC filter.

3. Study the diode clipper and Clamper circuits.
4. Study full wave bridge rectifier circuit: find ripple factor and observe output waveformwithout and with RC filter.
5. Study the V-I characteristic of Zener diode and find the breakdown voltage.
6. Study the voltage regulator circuit using full wave rectifier and Zener diode and find thepercentage of voltage regulation.
7. Study the characteristics of a common emitter RC couple transistor amplifier circuits.
8. Design, study and plot the input, output waveforms of following circuits using OP-AMP:
   (a) Adder
   (b) Subtractor
   (c) Integrator
   (d) Differentiator
   (e) Voltage follower
9. Study of Half and Full adder.
10. Study of Half and Full subtractor
11. Design 2:1 Multiplexer
12. Design 1:2 De multiplexer
13. Design Flip flop Circuits
14. Design Asynchronous Counter

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Identify** relevant information to supplement to the Analog Electronic Circuits course.	**PO2, PO4, PO5, PSO1, PSO3**
CO2	**Choose** testing strategies and select proper instruments to evaluate performance characteristics of electronic circuit.	**PO2, PO4, PO5, PSO1, PSO3**
CO3	**Construct** testing and experimental procedures on different types of electronic circuit and their operation in different operating conditions.	**PO2, PO4, PO5, PSO1, PSO3**
CO4	**Compare** possible causes of discrepancy in practical experimental observations to theory concepts.	**PO2, PO4, PO5, PSO1, PSO3**
CO5	**Explain** different types of wiring and instruments connections keeping in mind technical, Economical, safety issues	**PO2, PO4, PO5, PSO1, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12006	Prof. Core-III Lab (Electronics Lab)		3		3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

Course Code: MTH12531	Numerical Techniques Lab	L	T	P	C
Version 1.0		0	0	2	1
Pre-requisites/Exposure	Knowledge of 12th level Mathematics, Numerical Techniques and C/MATLAB Programming Language				
Co-requisites	--				

Course Objectives

1. To provide students hands-on experience of the implications of the various techniques used in numerical computations.
2. Create an understanding of algorithms and write computer programs to solve problems using numerical computing.
3. Solving non-linear equations and systems of linear equations, computing numerical interpolation and numerical integrations, and solving ordinary differential equations.
4. The ultimate goal of this course is to enhance the skill to think critically, model, and solve any mathematical problems.

Course Outcomes

On completion of this course, the students will be able to

CO1. Numerically **solve** non-linear equations related to univariate problems.
CO2. Numerically **solve a** system of linear equations related to multivariate problems.
CO3. **Obtain the** interpolated value of a known function at a finite number of points.
CO4. Numerically **compute** values of any definite integrals.
CO5. **Solve** initial value problems representing systems with spatial/temporal variations.

Catalog Description

Numerical computations are crucial in solving simple to complex problems in science and engineering. The growing power and efficiency of modern computers has made numerical computations more sophisticated, accurate and powerful. Practical knowledge of numerical computation techniques is very essential for modern science and engineering. This lab course is designed for undergraduate and B. Tech. Students to provide them comprehensive knowledge and practical experience of solving various mathematical problems using suitable numerical techniques. In this course, students will learn algorithms and write computer programs for numerical techniques for solving problems. The course includes strategies for solving non-linear equations and systems of linear equations, computing interpolations and integrations of functions, and solving ordinary differential equations. The course will help students to build the skill to model and solve real-life problems with simple to moderate levels of difficulty.

Course Content

Write C/ MATLAB programs to execute the followings:

1. The root of non-linear equation using Bisection method.
2. The root of non-linear equation using false position method.
3. The root of non-linear equation using Newton-Raphson method.
4. Interpolate values using Newton's forward Interpolation method.
5. Interpolate values using Newton's backward Interpolation method.
6. Interpolate values using Lagrange's interpolation method.
7. Solve a system of linear equation using gauss-elimination method.
8. Solve a system of linear equation using Gauss-Seidel method.
9. Evaluate the integral using different numerical integration rules. 10. Solve an ordinary differential equation using different numerical methods.

Text Books:

1. S. Dey, S. Gupta, Numerical Methods, McGraw Hill Education (India) Pvt. Ltd., 2013.
2. Amritava Gupta, S.C. Bose, Introduction to Numerical Analysis, 3rd Ed., Academic Publishers, 2013.
3. D. Kincaid and W. Cheney, Numerical Analysis: Mathematics of Scientific Computing, 3rd Ed., AMS, 2002.
4. K. E. Atkinson, An Introduction to Numerical Analysis, 2nd Ed., John Wiley& Sons, 1989.

Text Books:

1. Laurene V. Fausett, Applied Numerical Analysis Using MATLAB, 2nd Ed., Pearson, 2007.
2. B.S. Grewal, Numerical Methods in Engineering & Science: with Programs in C & C++, 11th Ed., Khanna Publishers, 2013.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Numerically **solve** non-linear equations to related univariate problems.	**PO1, PO2, PO3, PSO1**

CO2	Numerically **solve** system of linear equation related to multivariate problems.	**PO2, PO3, PO6, PSO1**
CO3	Obtain interpolated value of a function that is known at a finite number of points.	**PO1, PO3, PO9, PO12, PSO1**
CO4	Numerically **compute** values of any definite integrals.	**PO1, PO2, PO3, PO12, PSO1**
CO5	**Solve** initial value problems representing systems with spatial/temporal variations	**PO1, PO2, PO3, PO11, PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
XXXX	Numerical Techniques Lab	3	2		3	2	2								

1=weakly mapped

2= moderately mapped

3=strongly mapped

IDP14001	Interdisciplinary Project	L	T	P	C
Version 1.0	Contact Hours – 45	0	0	5	3
Pre-requisites/Exposure	Knowledge of Basic English				
Co-requisites	Knowledge of Basic Computer Skills				

Course Objective

1. To develop a student's knowledge of and appreciation for the interdisciplinary nature of knowledge and learning and importance
2. Value of integrating knowledge and perspectives from multiple disciplines as a means to evaluating and understanding complex topics, problems, issues, phenomena, and events
3. Competencies learned during the educational process and to apply these competencies in a real-world application.

Course Outcome

Upon successful completion of the course, students will be able to

CO1. **Explain** the unique advantages of integrative research and learning

CO2. **Illustrate** the fundamentals of research methods and practices of various academic disciplines

CO3. D**emonstrate** an understanding of current issues and concerns

CO4. **Utilize** the importance of ethics in research process

CO5. **Illustrate** the inter-disciplinary systems of research documentation

Course Description

This course will develop a student's knowledge of and appreciation for the interdisciplinary nature of knowledge and learning and importance and value of integrating knowledge and perspectives from multiple disciplines as a means to evaluating and understanding complex topics, problems, issues, phenomena, and events with competencies learned during the educational process and to apply these competencies in a real-world application

Course Content

1. After discussion with the Project Advisor(s), each student shall prepare an initial outline of their assigned project indicating the major sections of discussion, list the principal research sources for each section, and explain the overall objective of the project, including a justification of the interdisciplinary nature of the work.
2. Each student shall meet with the Project Advisor(s) regularly as per the weekly Time-Table. Other meetings may

be scheduled at the discretion of the Project Advisor(s) at mutually agreed upon timings.

3. Typically, the progress will include a combination of industrial and academic mentoring , self study sessions, case studies, trend studies, presentation by students, interactive sessions, industrial visits etc.
4. Regular submission of progress reports shall be required of each student-group as notified through the Project Advisor(s) from time to time.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Explain** the unique advantages of integrative research and learning	**PO1, PO3,PO12, PSO1, PSO2**
CO2	**Illustrate** the fundamentals of research methods and practices of various academic disciplines	**PO1, PO2, PO3 PO12,PSO1, PSO2**
CO3	**Demonstrate** an understanding of current issues and concerns	**PO1, PO2, PO3, PO12,PSO1, PSO2**
CO4	**Utilize** the importance of ethics in research process	**PO1,PO2, PO3, PO12, PSO1, PSO2**
CO5	**Illustrate** the inter-disciplinary systems of research documentation	**PO1, PO2, PO3, PO12, PSO1, PSO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
IDP14001	Interdisciplinary Project	3	3	3			-	-	-	-	-	-	3	3	3

1=weakly mapped
2= moderately mapped
3=strongly mapped

SOC14100	Community Service	L	T	P	C
Version 1.0	Contact Hours – 15	-	-	-	1
Pre-requisites/Exposure	Knowledge of Basic English				
Co-requisites	Knowledge of Basic Computer Skills				

Course Objectives

1. To familiarise the students on the concept 'giving back to the society'.
2. To familiarize the students on the issues faced by marginalized communities.
3. To provide an experiential platform to the students on any one or two issues as an internship.

Course Outcomes

On completion of this course, the students will be able to

CO1: **Utilize** the concept of social responsibility through an internship.

CO2: **Acquire** hands on experience in 'giving back to the society' through the concept of social responsibility through an internship.

Course Description

Along with Intelligent Quotient, it is important for students to enhance their Emotional Quotient as well. The Social Internship offers opportunity to the student to be empathetic towards social issues facing our society. To help and support the affected community / cause through a field internship is the essence of the course in 'giving back to the society'.

Course Content

Unit I:

Introduction to the course. A brief on social issues facing the society with both global and Indian examples.

Unit II:

Minimum 24 hours of field work on a social issue and helping the marginalized / affected community / cause with photographs and testimonies.

Unit III:

Submission of individual reflection on the social service rendered.

The benefits that accrue to the students are

A.) Subjective

1. Psychosomatic benefits: Volunteering increases overall life satisfaction and also helps to relive stress and acts as an anti-depressant.
2. Intellectual benefits: Enhances knowledge through new experiences, and develops communication skills.
3. Career benefits : Enhances career prospects by acquisition of work-related skills, builds good references for employers and provides a forum to network with future potential employers. It also The experience allows gained helps students to take up leadership positions. Letters of recommendation can also be easily sought. Research shows that students who indulge in volunteer word perform better in studies as it invigorates their passion for learning
4. Personal benefits : Real world skills like leadership, problem-solving, collaboration with others, time management and communication skills, learn patience and empathy.
5. Connect learning to real world and enables deeper and lifelong learning.

B.) **Community**

1. Collective benefits: Strong interpersonal bonds are created, and leads to increased civic and social awareness and responsibility.

Further Reading :

1. Tadevosyan, Gohar & Schoenhuth, Michael. Participatory Research Approach : Principles, Challenges and Perspectives. http://ysu.am/files/01G_Tadevosyan_M_Schoenhuth.pdf
2. Bergold, Jarg & Thomas Stefan. Participatory Research Methods: A Methodological Approach in Motion http://www.qualitative-research.net/index.php/fqs/article/view/1801/3334

Plan of Work

1. Reading on social issues facing the society with both global and Indian examples.
2. Selecting an issue where the student wishes to contribute and wants to make a difference.
3. Areas - The internship may be broadly completed by getting in touch with NGO in your city / town / Police / Municipal Corporation / Local Gram Panchayat / Hospital / State Health Department / Women & Child Development Centre / CSR departments of Corporates /school / Old Age Home / Orphanage / Literacy Drive / Aanganwadi Centres / etc.
4. **Online Discussion –** Through discussion, students elaborate their preferred area of work with reference to the Global Scenario and India. Reason for choosing that area also needs and resources of the people in their area of Social Internship and also submit the testimonials, which include signature of the authority where students initiated their work, or the signature of the authority in whose area students are currently working or photographs of work (photographs must include students working).
5. **Final Report Submission** - Submission of the Testimonials include signatures of the authorities you have worked with, or the signature of the authority in whose area you have worked or photographs of your work (photographs

must include you working). Students' accomplishment in their area of operation along with the major successes student experienced and major challenges faced.

6. Students will submit the complete elaborated report along with testimonials and completion certificate in the form of signed Template

- The registration for all students will open twice, during winter and summer breaks. They may enroll for the internship in either of the two breaks.
- The student will have to submit a continuous record of their 10 to 15 days internship in the form of photographs and testimonies (wherever required).

Mode and Scheme of Online Evaluation:

Modes of Evaluation: Online – Quiz / Assignment / Discussions / Case Studies

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	**50**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Utilize** the concept of social responsibility through an internship.	**PO6, PO9, PO12**
CO2	**Acquire** hands on experience in 'giving back to the society' through the concept of social responsibility through an internship.	**PO6, PO9, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
SOC14100	Community Service						3			3			3		

1=weakly mapped

2= moderately mapped

3=strongly mapped

SEMESTER – IV

BME11007	Prof. Core- IV (Basic Clinical Science)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Engineering Mathematics -I & II				
Co-requisites	--				

Course Objectives

The student should be made to

1. To provide an in-depth knowledge of the core principles, biochemical & biophysical processes, and their experimental basis.
2. To enable students to acquire a concept and understanding of the theoretical and technical basis for biophysical & biochemical definition and determination of macromolecular structure.
3. This course focuses on the phenomena related to the interaction and communication between living cells and their molecular constituents.
4. This course drawing on advanced methods used within the fields of molecular, cellular and clinical biochemistry and biophysics.

Course Outcomes

CO1. Acquire, articulate and retain broad and in-depth knowledge and understanding of the ways by which life functions are explained in terms of the principles of chemistry and physics and fundamental processes of Biochemistry and Biophysics.

CO2. Identify and analyze complex problems related to Formation of Structures in Biological Systems, Structural-Functional Relationships of Nucleic Acid and proteins, Biophysical activity, Radioactivity to arrive at suitable conclusions using first principles of Biophysics and Biochemistry.

CO3. Design, develop and conduct investigations to evaluate and interpret results to solve problems related to Cellular Biochemistry, Biophysical and Biochemical activity.

CO4. Apply appropriate techniques, resources, modern engineering tools including prediction and modeling to complex biophysical, biochemical and biomolecular activities with an understanding of the limitations to demonstrate concepts in Clinical Science.

CO5. Become familiar with the complexity of issues in the biochemistry, biophysics, and molecular biology domain, including scientific and moral ethics, cultural diversity, environmental concerns and in turn develops an awareness of ethical responsibilities while conducting and reporting investigations.

Catalog Description

For engineering course, Mathematics is the backbone. Students will be having good engineering skills if their idea for Mathematics is clear. In this course the focus will be to learn Mathematics in depth which will motivate students to grow their thinking ability for Engineering also. By knowing the theory student will be able to apply that successfully to all kind of problems of Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities (Problem solving, presentation etc.).

Course Content

Module 1:

Basics techniques of clinical biochemistry: Laboratory equipment, Principle & Applications of Immunoassay techniques, Electrophoresis, Polymerase Chain Reaction, Autoanalyzers, Chromatography, Photometry: principle, types of photometry–colorimetry, spectrophotometry, flame photometry.

Module 2:
Applied clinical biochemistry: Laboratory principles and safety measures, Specimen collection, Processing of tissue, blood and urine, Full blood count, Blood glucose regulation and role of hormones, estimation of glucose, Lipid profile estimation, Bone profile estimation, Protein estimation, Renal Function Tests, Gastric Function Test, Liver Function Tests, Cardiac Profile Tests.

Module 3:
Basics of clinical microbiology: Laboratory & Aseptic Techniques, Culturing Microorganisms, Staining Methods, Classification of microorganisms, Study of bacteria, fungi, and viruses and their diseases, Infection and pathogenicity

Module 4:
Clinical microbiology: Transport & Examination of specimen in clinical diagnostic laboratory, Quality control, Basic microscopy for clinical microbiology, Antibiotic sensitivity testing, Serological Diagnosis of Microbial Diseases, Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods.

Text Books:

1. D M Vasudevan, Text book of Biochemistry for medical students, 6th edition Jaypee
2. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education

Reference Books:

1. Lehninger (2013), Principles of Biochemistry, 6th edition, W H Freeman
2. Mohanty S and Verma A (2013), Practical Clinical Biochemistry, 1st edition, Jaypee
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs

	Course Outcomes (COs)	Mapped Program Outcomes
CO1	Acquire, articulate and retain broad and in-depth knowledge and understanding of the ways by which life functions are explained in terms of the principles of chemistry and physics and fundamental processes of Biochemistry and Biophysics.	**PO6, PO11, PSO3**
CO2	Identify and analyze complex problems related to Formation of Structures in Biological Systems, Structural-Functional Relationships of Nucleic Acid and proteins, Biophysical activity, Radioactivity to arrive at suitable conclusions using first principles of Biophysics and Biochemistry.	**PO6, PO11, PSO3**
CO3	Design, develop and conduct investigations to evaluate and interpret results to solve problems related to Cellular Biochemistry, Biophysical and Biochemical activity.	**PO6, PO8, PO11, PSO3**
CO4	Apply appropriate techniques, resources, modern engineering tools including prediction and modeling to complex biophysical, biochemical and biomolecular activities with an understanding of the limitations to demonstrate concepts in Clinical Science.	**PO6, PO8, PO11, PSO3**
CO5	Become familiar with the complexity of issues in the biochemistry, biophysics, and molecular biology domain, including scientific and moral ethics, cultural diversity, environmental concerns and in turn develops an awareness of ethical responsibilities while conducting and reporting investigations.	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME11007	Prof. Core-IV (Basic Clinical Science)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11008	Prof. Core- V (Biomedical Signal acquisition & processing)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objectives

1. Understand characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG, and EMG.
2. Understand choice of filters to remove noise and artifacts from biomedical signals.
3. Apply established engineering methods to analyse ECG signal problems.
4. Apply established engineering methods to analyse neurological signals.
5. Analyse various biomedical signals through advanced techniques.

Course Outcomes

CO1. Understand the fundamental techniques & applications of digital signal processing with emphasis on biomedical signals.
CO2. Implement algorithms based on discrete time signals.
CO3. Understand circular and linear convolution and their implementation in DFT and analyze signals.
CO4. Understand efficient computation techniques such as DIT and DIF FFT Algorithms.
CO5. Design FIR filters using digital IIR filters by designing prototype analog filters and then applying analog to digital conversion.

Course Description

Programming skills are mandatory for designing or solving problems through digital device. It is the language through which computational/digital devices are communicated rather interfaced. To develop any software programming language is a must. In present era almost all aspect of life is somehow largely related to virtualization and digital data/information. Devices from smartphones to other handheld devices, drones, cameras, medical instruments etc. all needs programming at some part. In engineering it has become quintessential for the students/research scholars to learn programming. In this course, students will learn how to solve problems in various domains through a programming language. This course enables students with the basic skills of C Programming Language. Five Different related modules comprise this course. First Unit familiarizes students with basics of computers, algorithmic method to solve problem, introduction to generic programming construct. Basics of C Programming is upto iterative structure is depicted in Unit II. In Unit III students will learn about modularization using functions and one advance concept of C Programming, Pointers. Unit IV will cover one of the most important concepts in C Programming, Array and Strings. Unit V will accomplish this course with the advance concept like Structure, Union and File Handling. After this course students will grow their analytical ability to solve problem and logical skill. Also, this course effectively creates the ability to grasp any other Programming Language in easier manner**.**

Course Content

Module I: **7 lecture hours**

Introduction to Digital Signal Processing:

Types of signal and systems, Origins of bio-signals: EMG, ECG, EEG, EOG, PCG; Sources of noise, application of DSP in biomedical engineering.

Module II: **11 lecture hours**

Frequency Domain Analysis of Discrete Time Signals and Systems:

Z-transform, Z-transform properties, Inverse z-transform, System analysis using Z transform, Discrete Fourier analysis, Discrete-Time Fourier Transform (DTFT), Inverse DTFT. Discrete Fourier Transform (DFT), Inverse DFT. Fast Fourier Transform, Types of FFT, N-point Radix-2 FFT, Inverse FFT.

Module III: **09 lecture hours**

Structures of Discrete-Time Systems:

Realization of discrete-time systems, FIR systems: Direct, Cascade, Frequency Sampling and Lattice structures. Structures for IIR systems: Direct, Signal Flow Graphs and Transposed, Cascade, Parallel, Lattice and Lattice-Ladder structures. State space system analysis and structures

Module IV: **09 lecture hours**

FIR Filter Design

Symmetric and Anti-symmetric FIR filters, FIR Filter design by window method (Rectangular, Bartlett, Hamming, Hanning, Blackman and Kaiser window), Frequency Sampling method, Optimum approximation of FIR filters, Design of FIR differentiators, Design of Hilbert transformers

Module V: **09 lecture hours**

IIR Filter Design

Design of Discrete-time IIR filters from Continuous-time Filters: Filter design by Impulse invariant and bilinear transformation method: Butterworth, Chebyshev and Elliptic approximation Filter, Frequency transformation.

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson
2. Discrete Time Signal Processing by A.V. Oppenheim, R. W. Schafer, & John R. Buck, , 2nd Edition, Prentice Hall, 1999.

Reference Books:

1. Digital Signal Processing: Fundamentals and Applications – Li Tan, Academic Press, Elsevier.
2. Digital Signal Processing – S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the fundamental techniques & applications of digital signal processing with emphasis on biomedical signals.	**PO6, PO11, PSO3**
CO2	Implement algorithms based on discrete time signals.	**PO6, PO11, PSO3**
CO3	Understand circular and linear convolution and their implementation in DFT and analyze signals.	**PO6, PO8, PO11, PSO3**
CO4	Understand efficient computation techniques such as DIT and DIF FFT Algorithms.	**PO6, PO8, PO11, PSO3**
CO5	Design FIR filters using digital IIR filters by designing prototype analog filters and then applying analog to digital conversion	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11008	Prof. Core- V (Biomedical Signal acquisition & processing)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11009	Prof. Core- VI (Microprocessors and Microcontrollers)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objective

1. To learn the design aspects of I/O and Memory Interfacing circuits.
2. To interface microprocessors with supporting chips.
3. To study the Architecture of the 8051 microcontrollers.
4. To design a microcontroller-based system.

Course Outcomes

After completing the course, the student will be able to

1. Understand and explain the 8085 and 8086 microprocessor and 8051 microcontrollers.
2. Interface external devices like sensors, memory, keyboard, etc. with the microprocessor as well as a microcontroller.
3. Design an embedded system.
4. Write programs in assembly language and C language.
5. Study the advanced microcontroller and control the different physical parameters.

Catalog Description

Programming skills are mandatory for designing or solving problems through digital device. It is the language through which computational/digital devices are communicated rather interfaced. To develop any software programming language is a must. In present era almost all aspect of life is somehow largely related to virtualization and digital data/information. Devices from smartphones to other handheld devices, drones, cameras, medical instruments etc. all needs programming at some part. In engineering it has become quintessential for the students/research scholars to learn programming. In this course, students will learn how to solve problems in various domains through a programming language. This course enables students with the basic skills of C Programming Language. Five Different related modules comprise this course. First Unit familiarizes students with basics of computers, algorithmic method to solve problem, introduction to generic programming construct. Basics of C Programming is upto iterative structure is depicted in Unit II. In Unit III students will learn about modularization using functions and one advance concept of C Programming, Pointers. Unit IV will cover one of the most important concepts in C Programming, Array and Strings. Unit V will accomplish this course with the advance concept like Structure, Union and File Handling. After this course students will grow their analytical ability to solve problem and logical skill. Also, this course effectively creates the ability to grasp any other Programming Language in easier manner.

Course Content

Module I: **10 lecture hours**

Introduction to Microprocessor: Microcomputer based system. History Evolution of Microprocessor and microcontrollers and their advantages and disadvantages. 1 Architecture of 8085 Microprocessor. Address / Data Bus multiplexing and demultiplexing. Status and Control signal generation. Instruction set of 8085 Microprocessor. Classification of instructions, addressing modes, timing diagram of the instructions. Assembly language programming: Addition, Multiplication, Block Transfer, etc. Interrupts of 8085 processor: classification of interrupts, Programming using interrupts. Serial and parallel data transfer – Basic concept of serial I/O, DMA, Asynchronous and synchronous serial transmission using SID and SOD pins of 8085 Microprocessor.

Module II: **8 lecture hours**

The 8086 microprocessors: Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts. Assembly language programming: Addition, Multiplication, Block Transfer etc.

Module III: **8 lecture hours**

8051 architecture: 8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts. Assembly language Programming using 8051 Moving data: External data moves, code memory read only data moves, PUSH and POP opcodes, data exchanges. Logical operations: Byte-level, bit-level, rotate and swap operations. Arithmetic operations: Flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic. Jump and call instructions: Jump and call program range, jumps, calls and subroutines, interrupts and returns.

Module IV: **8 lecture hours**

Support IC chips: 8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing of support IC chips with 8085, 8086 and 8051

Module V: **9 lecture hours**

Memory interfacing: Memory interfacing with 8085, 8086 & 8051. ADC / DAC interfacing with 8085, 8086 & 8051. Brief introduction to PIC microcontroller (16F877): Architecture, PIN details, memory layout etc.

Text Books

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar (Penram International)
2. Ray &Bhurchandi, Advanced Microprocessors & Peripherals, TMH
3. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)
4. Fundamental of Microprocessors and Microcontroller-B Ram,Dhanpat rai publication

Reference Books

1. The 8051 microcontroller - K. Ayala (Thomson)
2. Microprocessors & interfacing – D. V. Hall (Tata McGraw-hill)
3. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan (Oxford university press).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand and explain the 8085 and 8086 microprocessor and 8051 microcontrollers.	**PO6, PO11, PSO3**
CO2	Interface external devices like sensors, memory, keyboard, etc. with the microprocessor as well as a microcontroller	**PO6, PO11, PSO3**
CO3	Design an embedded system	**PO6, PO8, PO11, PSO3**
CO4	Write programs in assembly language and C language.	**PO6, PO8, PO11, PSO3**
CO5	Study the advanced microcontroller and control the different physical parameters	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11009	Prof. Core- VI (Microprocessors and Microcontrollers)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11010	Prof. Core- VII (Biomaterials)	L	T	P	C
Version 1.0	Contact Hours - 60	3	1	0	4
Pre-requisites/Exposure	10+2 Level Chemistry, Knowledge of Biology and Physics				
Co-requisites	--				

Course Objectives

The student would be able to learn the characteristics and classification of Biomaterials.

1. Understand polymeric materials, composites, and combinations that could be used as tissue replacement implants.
2. Students should be able to understand how to develop artificial organs using these materials.
3. Instill a fundamental understanding of the properties and applications of biomaterials, both natural and synthetic that are used in contact with biological systems in the area of various tissues and organ replacement.
4. To acquaint students with the interactions between biomaterials and the human body that lead to the failure of devices.
5. This course presents a balanced perspective on the evolving discipline of Biomaterials Science by including information on hard biomaterials and soft biomaterials, orthopedic ideas, cardiovascular concepts, ophthalmologic ideas, and dental issues.
6. Demonstrate in-depth knowledge of the mechanical and biological properties of both natural and synthetic biomaterials used in implant design and artificial tissue or organ making.
7. Describe the role of adsorbed proteins and cells in the tissue response to biomaterials.
8. Appreciate the complex mechanical and biological interactions between biomaterials and biological systems.
9. Gain a solid appreciation for the special significance of the word biomaterial as well as the rapid and exciting evolution and expansion of biomaterials science and its applications in health care.

Course Outcomes

CO1. Analyze different types of Biomaterials and their classification and apply the concept of nanotechnology towards biomaterials use.
CO2. Identify significant gaps required to overcome challenges and further development in metallic and ceramic materials.
CO3. Identify significant gaps required to overcome challenges and further development in polymeric materials.
CO4. Create combinations of materials that could be used as a tissue replacement implant.
CO5. Understand the testing standards applied for biomaterials.

Catalog Description

Programming skills are mandatory for designing or solving problems through digital device. It is the language through which computational/digital devices are communicated rather interfaced. To develop any software programming language is a must. In present era almost all aspect of life is somehow largely related to virtualization and digital data/information. Devices from smartphones to other handheld devices, drones, cameras, medical instruments etc. all needs programming at some part. In engineering it has become quintessential for the students/research scholars to learn programming. In this

course, students will learn how to solve problems in various domains through a programming language. This course enables students with the basic skills of C Programming Language. Five Different related modules comprise this course. First Unit familiarizes students with basics of computers, algorithmic method to solve problem, introduction to generic programming construct. Basics of C Programming is upto iterative structure is depicted in Unit II. In Unit III students will learn about modularization using functions and one advance concept of C Programming, Pointers. Unit IV will cover one of the most important concepts in C Programming, Array and Strings. Unit V will accomplish this course with the advance concept like Structure, Union and File Handling. After this course students will grow their analytical ability to solve problem and logical skill. Also, this course effectively creates the ability to grasp any other Programming Language in easier manner.

Course Content

Module 1: Biomaterial – Classification of biomaterials – Natural and synthetic materials - Properties of biomaterials - Bulk and surface properties – Biocompatibility – Assessment of biocompatibility of biomaterials. Various classes of biomaterials - Metals, Ceramics, Polymers and Composites – Implantable biomaterials – Temporary or permanent implants – Bio-degradable and non-biodegradable materials.

Module 2: Cell-biomaterial interactions – Interactions between human tissue and biomaterials - Wound healing – Foreign-Body response - Pathological response to implants.

Module 3: Blood-material interactions – Evaluation of blood material interactions – Hemocompatibility – *In Vivo* testing and histocompatibility assessment.

Module 4: Applications of biomaterials in medicine - Soft and hard tissue replacements - Dental implants - Intraocular lens – Metallic hip joint.

Text Books:

1. Buddy D. Ratner. Biomaterials science: an introduction to materials in medicine.
2. Frederick H. Silver, David L. Christiansen-Biomaterials Science and Biocompatibility-Springer-Verlag New York (1999)

Reference Books:

1. Pignatello R. - Advances in Biomaterials Science and Biomedical Applications
2. Qing Li, Yiu-Wing Mai (eds.) - Biomaterials for Implants and Scaffolds-Springer-Verlag Berlin Heidelberg (2017)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Analyze different types of Biomaterials and their classification and apply the concept of nanotechnology towards biomaterials use.	**PO6, PO11, PSO3**
CO2	Identify significant gaps required to overcome challenges and further development in metallic and ceramic materials.	**PO6, PO11, PSO3**
CO3	Identify significant gaps required to overcome challenges and further development in polymeric materials	**PO6, PO8, PO11, PSO3**
CO4	Create combinations of materials that could be used as a tissue replacement implant.	**PO6, PO8, PO11, PSO3**
CO5	Understand the testing standards applied for biomaterials	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11010	Prof. Core-VII (Biomaterials)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11016	Prof. Core- XI (Medical Imaging Systems)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objectives:

1. To extend your knowledge of the technical basis for advanced medical imaging systems and develop the skills to critically evaluate the performance and outputs of such systems.
2. To develop a comprehensive understanding of the functionality of advanced medical imaging systems including time-resolved, hybrid and treatment-room-integrated.

Course Outcomes:

After completion of this course, students will be able to –

CO1. Advanced and integrated understanding of the applications of physical processes to the diagnosis and treatment of disease, including an understanding of contemporary developments in professional practice.

CO2. Advanced understanding of the origins of radiation and its interactions with matter pertaining to the production and use of ionizing radiation, with particular regard to the protection of people and environments.

CO3. Develop an understanding of the different modalities in Radiology and recognize the images of each modality.

CO4. Describe the differences between the modalities, the method of imaging and safety precautions

Course Description

This course is intended to impart the versatile advanced imaging techniques, their operating principle, applications & related modalities in healthcare system.

Course Content

Unit 1: Microscopy: Basic principles, advantages and limitations optical microscope; Different types of microscopy techniques: Brightfield, Darkfield, Phase contrast, Reflected Interference Contrast (RIC), Fluorescence, Confocal, Deconvolution, Wide Field: STORM/PALM, Serial time-encoded amplified microscopy (STEAM).

Basic principles, techniques, advantages and limitations of a) electron microscope: transmission electron microscope (TEM), scanning electron microscope (SEM), scanning transmission electron microscope (STEM); b) ultramicroscope; c) scanning probe microscope: Scanning tunneling microscope (STM), Atomic Force Microscope (AFM).

Unit 2: Radiography and X-ray based Computed Tomography: Basic principle; Equipment: source, detector, contrast agents; Backscatter X-ray; Fluoroscopy: Basic principles and equipments, X-ray image intensifier; Rotational Angiography; Mammography; Dual-energy X-ray absorptiometry (DEXA). X-ray image processing; Radiobiology and

Radiation Safety: Biological effects of Radiation; Radiation dose: effects of time, distance and shielding.

Unit 3: Tomographic techniques: Basic principle of X-ray based computed tomogrpahy; Equipment; Contrast agents; special procedures: Electron beam tomography (EBT); Spiral computed tomography: principles and advantages over conventional technique. single-slice spiral computed tomography (SSCT), multi-slice spiral computed tomography (MSCT). X-ray microtomography (μCT) and High Resolution computed tomography (HRCT): principles and advantages. Three-dimensional image reconstruction of CT scan images.

Unit 4: Magnetic Resonance Imaging (MRI): Nuclear Magnetic Resonance (NMR); Nuclear precession; effect of external magnetic field on magnetic moments, Equilibrium magnetization significance of Radio frequency (RF) pulse, Resonance and larmor frequency. MRI equipments. T1 and T2 Relaxation. Different MRI methods; fMRI: BOLD.

Unit 5: PET and SPECT: Positron emission tomography (PET), PET-CT and PET-MRI; Single-photon emission computed tomography (SPECT), SPECT/CT; Electrical impedance tomography (EIT): a-EIT, f-EIT, MF-EIT; Electron tomography (ET); Magnetic particle imaging (MPI). Magnetic resonance elastography.

Unit 6: Medical ultrasonography and endoscopy: Basic principles; Modes of ultrasonography: A-scan B-scan M-mode imaging and echocardiography; Use of Doppler techniques in ultrasound. Velocity vector imaging (VVI). Ultrasound elastography.

Text Book(s):

1. K. Kirk Shung, Michael Smith, Benjamin M.W. Tsui; Principles of Medical Imaging; Academic Press; 1992.
2. Ed: Jacob Buetel, Harold L. Kundel, Richard L. van Metter; Handbook of Medical Imaging, Volume 1: Physics and Psychophysics; SPIE; 2000.

Reference Book(s):

1. Chris Guy, Dominic Ffytche; An introduction to the principles of medical imaging; Imperial College Press; Distributed by World Scientific Pub; 2005.
2. R. Khandpur; Biomedical Instrumentation: Technology and Applications; McGraw-Hill Professional; 2004.
3. John G. Webster; Medical Instrumentation Application and Design; 4th Edition; 2009.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Advanced and integrated understanding of the applications of physical processes to the diagnosis and treatment of disease, including an understanding of contemporary developments in professional practice.	**PO6, PO11, PSO3**
CO2	Advanced understanding of the origins of radiation and its interactions with matter pertaining to the production and use of ionizing radiation, with particular regard to	**PO6, PO11, PSO3**

	the protection of people and environments.	
CO3	Develop an understanding of the different modalities in Radiology and recognize the images of each modality.	**PO6, PO8, PO11, PSO3**
CO4	Describe the differences between the modalities, the method of imaging and safety precautions	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME11016	Prof. Core-XI (Medical Imaging Systems)						3		3			3				3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

PSG11021	Human Values and Professional Ethics	L	T	P	C
Version 1.0	Contact Hours - 30	2	0	0	2
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objective

1. To enable the students to generate an awareness on Engineering Ethics and Human Values.
2. To instill Moral and Social Values into the students mind.
3. To realize the social responsibility as an engineer.
4. To appreciate Loyalty and to be aware of the rights of others.

Course Outcomes

After completing the course, the student will be able to

CO1. The student should be able to apply ethics in society,
CO2. Able to discuss the ethical issues related to engineering responsibilities.
CO3. Realize the responsibilities and rights in the society.

Course Description

Human values and professional ethics are complementary to each other. Whereas human values convey personal conviction, ethics describe the accepted principles and standards of conduct about moral duties and virtues as applied to an organization.

Course Content

Module I: Introduction to Human Values: Character, Integrity, Credibility, Mutual Respect, Dedication, Perseverance, Humility and Perception. Self-Assessment & Analysis, Setting Life Goals, Consciousness and Self-Transformation. Team Work, Conflict Resolution, Influencing and Winning People, Anger Management, Forgiveness and Peace, Morality, Conscience. Yoga and Spirituality

Module II: Harmony and Life Long Learning: Harmony in human being, Nature and Existence. Harmony in family and society –Responsibilities towards society, Respecting teachers. Transition from School to College - Freedom & Responsibilities, Respecting Cultural Diversity, Learning beyond the Classrooms, Independent study and research

Module III: Introduction to Professional Ethics: Work Ethics, Engineering Ethics, Moral Dilemma, Moral Development Theories, Ethical Theories- Kantinism, Utilitarianism, etc , Case Studies for Choice of the theory, Code of Ethics

Module IV: Individual to Global Issues: Industrial Standards, A Balanced Outlook on Law, Safety, Responsibility, Rights, Confidentiality, Conflict of Interest, Occupational Crime, Whistle Blowing, Environmental Ethics, Business Conduct in MNC, E-Professionalism (IPR, Internet Ethics & Privacy issues)

Text Books

1. Shetty, Foundation Course in Human Values and Professional Ethics [R.R. Gaur, R. Sangal, G.P. Bagaria]

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	The student should be able to apply ethics in society,	**PO6, PO11, PSO3**
CO2	Able to discuss the ethical issues related to engineering responsibilities.	**PO6, PO11, PSO3**
CO3	Realize the responsibilities and rights in the society	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
PSG11021	Human Values and Professional Ethics						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12011	Prof. Core- V Lab (Digital Signal Processing Lab)	L	T	P	C
Version 1.0	Contact Hours - 45	2	0	0	2
Pre-requisites/Exposure	Knowledge in Digital Electronics				
Co-requisites	--				

Course Objectives

1. To perform primary signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB.
2. To implement FIR and IIR filters in MATLAB and DSP Processor
3. To study the architecture of DSP processor
4. To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts**.**

Course Outcomes

CO1. Carryout basic signal processing operations.
CO2. Demonstrate their abilities towards MATLAB-based implementation of various DSP systems.
CO3. Analyze the architecture of a DSP Processor.
CO4. Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals.
CO5. Design a DSP system for various applications of DSP.

Catalogue Description

For engineering courses, Mathematics is the backbone. Students will have good engineering skills if their idea for Mathematics is clear. In this course, the focus will be on learning Mathematics in depth, which will motivate students to grow their thinking ability for Engineering also. By knowing the theory, a student will be able to apply that successfully to all kinds of problems in Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to participate actively in all group activities (Problem-solving, presentation, etc.).

Course Content

List of experiments:

1. Generation of different types of waveform using MATLAB.

2. Conversion of continuous time signals to discrete sequence/signals.

3. Generation of an arbitrary discrete sequence

4. Perform linear convolution of two sequences without using MATLAB “conv” command.

5. Perform cross correlation of two sequences without using MATLAB “corr” command.

6. Plot pole-zero for a given sequence and systems.

7. Perform Discrete Fourier Transform using Matrix Multiplication

8. Implementation of circular convolution of the two given sequences using DFT based approach.

9. Perform linear convolution of a finite length sequence with an infinite length sequence using overlap add method

h[n]={1,1,1} and x[n]={3,-1,0,1,3,2,0,1,2,1}

10. Design low pass, high pass and band pass IIR Butterworth direct form -1 digital filter using the Filter-builder command.

11. Design low pass, high pass and band pass IIR Butterworth direct form -1 digital filter using the FDA tool.

12. Design low pass, high pass and band pass IIR Butterworth direct form -1 digital filter using MATLAB.

13. Write a Matlab code to design an FIR filter using window method

14. Design a 25 tap low-pass FIR filter with cut off frequency 0.5pi radian using window method.

15. Design a 25 tap low-pass FIR filter with cut off frequency 0.5pi radian using window method and plot the responses using fvtool.

16. Familiarization with the CC Studio and TI 6713 DSP.

17. Display a message ("ADAMAS UNIVERSITY") in the monitor by writing a program in CC Studio environment and porting it to TI 6713 DSP.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Carryout basic signal processing operations.	**PO6, PO11, PSO3**
CO2	Demonstrate their abilities towards MATLAB-based implementation of various DSP systems.	**PO6, PO11, PSO3**
CO3	Analyze the architecture of a DSP Processor.	**PO6, PO8, PO11, PSO3**
CO4	Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals.	**PO6, PO8, PO11, PSO3**
CO5	Design a DSP system for various applications of DSP	**PO6, PO8, PO11,**

		PSO3

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME12011	Prof. Core- V Lab (Digital Signal Processing Lab)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12012	Prof. Core- VI Lab (Microprocessors and microcontrollers Lab)	L	T	P	C
Version 1.0	Contact Hours - 45	0	0	2	2
Pre-requisites/Exposure	Knowledge in Digital Electronics				
Co-requisites	--				

Course Objectives

1. To Introduce ALP concepts, features and Coding methods.
2. Write ALP for arithmetic and logical operations in 8086 and 8051.
3. Differentiate Serial and Parallel Interface.
4. Interface different I/Os with Microprocessors.
5. Be familiar with MASM.

Course Outcomes

CO1. Write ALP Programmes for fixed and Floating Point and Arithmetic operations
CO2. Interface different I/Os with processor
CO3. Generate waveforms using Microprocessors
CO4. Execute Programs in 8051
CO5. Explain the difference between simulator and Emulator

Catalogue Description

For engineering courses, Mathematics is the backbone. Students will have good engineering skills if their idea for Mathematics is clear. In this course, the focus will be on learning Mathematics in depth, which will motivate students to grow their thinking ability for Engineering also. By knowing the theory, a student will be able to apply that successfully to all kinds of problems in Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to participate actively in all group activities (Problem-solving, presentation, etc.).

List of experiments:

1. Familiarization with 8085, 8086 processors & 8051 controller Kit.
2. Add two 8 bit numbers and stored at consecutive memory location.
3. Subtract two 8 bit numbers and stored at consecutive memory location.
4. To multiply two 8 bit numbers and stored at consecutive memory location.
5. To divide two 8 bit numbers and stored at consecutive memory location.
6. To find the largest element in an array.
7. To find the smallest element in an array.
8. To sort the given number in ascending order

9. To sort the given number in descending order

10. To convert decimal to hexadecimal.

11. To convert hexadecimal to decimal.

12. BCD addition.

13. BCD subtraction.

14. Copying a block of memory

15. Shifting a block of memory

16. Interfacing Keyboard and Multi-digit Display with multiplexing using 8255

17. Interfacing Stepper Motor.

18. Interfacing ADC and DAC.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Write ALP Programmes for fixed and Floating Point and Arithmetic operations	**PO6, PO11, PSO3**
CO2	Interface different I/Os with processor	**PO6, PO11, PSO3**
CO3	Generate waveforms using Microprocessors	**PO6, PO8, PO11, PSO3**
CO4	Execute Programs in 8051	**PO6, PO8, PO11, PSO3**
CO5	Explain the difference between simulator and Emulator	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12012	Prof. Core- VI Lab (Microprocessors and microcontrollers Lab)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

SEMESTER -V

BME11013	Prof. Core- VIII (Biomechanics)	L	T	P	C
Version 1.0	**Contact Hours –**	3	0	0	3
Pre-requisites/Exposure	Fundamentals of Mechanics				
Co-requisites	--				

Course Objectives:

1. To describe the fundamental of biomechanics.
2. To Study the deformability, strength, viscoelasticity of bone and flexible tissues, modes of loading and failure.
3. To describe the types and mechanics of skeletal joints.
4. To describe movement precisely, using well defined terms (kinematics) and also to consider the role of force in movement (kinetics).
5. To teach students the unique features of biological flows, especially constitutive laws and boundaries.
6. To consider the mechanics of orthopedic implants and joint replacement, artificial heart valve, mechanical properties of cardiovascular and respiratory mechanics

Course Outcomes:

After completion of the course student will be able to

CO1. Understand the fundamentals of mechanics and its application in human system.
CO2. Describe the flow properties of blood, various properties of hard tissues (bone) & soft tissues (articular cartilage, tendons and ligaments) and identify the appropriate model to demonstrate mechanical behavior.
CO3. Analyze the biomechanics of different human joints and also the forces at a skeletal joint for various static and dynamic human activities.
CO4. Gain broad working knowledge about the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement and dynamics of the human body.
CO5. Demonstrate a detailed understanding of the design requirements of medical implants based on the human anatomy and biological responses to biomaterials.

Course Description

This is a first level course to learn the fundamental of biomechanics. This study covers the types and mechanics of skeletal joints, deformability, strength, viscoelasticity of bone and flexible tissues. Students will be able to learn detailed understanding of the design requirements of medical implants based on the human anatomy and biological responses to biomaterials. Students will be expected to be familiar with engineering problems related to practical field.

Course Content

Module 1: Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions. Strength of materials.
Module 2: Hard Tissues: Definition of Stress and Strain; Deformation Mechanics. Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy, Fatigue Analysis

Module 3: Soft Tissues: Structure, functions, material properties and modelling of Soft Tissues: Cartilage, Tendon, Ligament, Muscle - Hodgkin-Huxley Model.
Module 4: Human Joints and Movements: Skeletal joints, forces and stresses in human joints, types of joint, biomechanical analysis joints, parameterization and analysis in Gait,
Module 5: Biofluid mechanics: Flow properties of blood, Dynamics of fluid flow in the intact human cardiovascular system - modelling and experimental approaches, Pulse wave velocities in arteries, Measurement/Estimation of In-vivo elasticity of blood vessels

Text Book(s):

1. Subrata Pal, Text book of Biomechanics, Viva education private limited, 2009.

Reference Book(s):

1. Y.C.Fung, Biomechanics: Mechanical properties in living tissues, Springer Verlag, New York, 1981.
2. Susan J.Hall, Basic Biomechanics; 5th Edition, McGraw-Hill Publishing Co, Newyork, 2007.
3. C.R Ethier and C.A.Simmons, Biomechanics from cells to organisms, Cambridge University Press, 2007.
4. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
5. Basic Biomechanics of the Musculoskeletal System; Margareta Nordin and Victor H Frankel; 3rd Edition; Wolters Kluwer.; 2011.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand** the fundamentals of mechanics and its application in human system.	**PO1, PO2, PO3, PO4, PSO3**
CO2	**Describe** the flow properties of blood, various properties of hard tissues (bone) & soft tissues (articular cartilage, tendons and ligaments) and identify the appropriate model to demonstrate mechanical behavior.	**PO1, PO2, PO3, PO4, PSO3**
CO3	**Analyze** the biomechanics of different human joints and also the forces at a skeletal joint for various static and dynamic human activities.	**PO1, PO2, PO3, PO4, PSO3**
CO4	**Gain** broad working knowledge about the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement and dynamics of the human body.	**PO1, PO2, PO3, PO4, PSO3**
CO5	**Demonstrate** a detailed understanding of the design requirements of medical implants based on the human anatomy and biological responses to biomaterials.	**PO1, PO2, PO3, PO4, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11013	Prof. Core-VIII (Biomechanics)	3	3	3	3											3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11014	Prof. Core- IX (Digital System Design)	L	T	P	C
Version 1.0	**Contact Hours –**	3	0	0	3
Pre-requisites/Exposure	Fundamentals of Mechanics				
Co-requisites	--				

Course Objectives:

Course Outcomes:

After completion of this course, students will be able to –

CO1. Understand the fundamental concepts and techniques used in digital electronics.

CO2. Explain the working mechanism and design guidelines of different combinational and sequential circuits.

CO3. Classify different logic families, semiconductor memories and PLD devices.

CO4. Illustrate reduction of logical expressions using Boolean algebra and k-map.

CO5. Implement Digital Logic circuits using VHDL and functions using logic gates.

Course Description

Course Content

Module 1 (Switching theory): Switching algebra,, switching functions, truth tables and switching expressions – canonical forms, sum-of-product (disjunctive normal) form (dnf) and product-of-sum (conjuctive normal) form (cnf); minimization of completely and inc completely specified switching functions

[7L]

Module 2 (Combinational logic circuits): Logic gates, Realization of Boolean functions using logic gates

– 2 level AND-OR circuits for dnf, 2 level OR-AND circuits for cnf; universality of NAND/NOR gates; Logic families: TTL, nMOS, CMOS, pass transistor logic (PTL) gates; Multi-output logic circuit minimization; Decoders, multiplexers. logic design using ROMs, PLAs and FPGAs

[10L]

Module 3 (Sequential circuits): latches and flip-flops (FFs); synchronous and asynchronous inputs; edge triggered and master-slave Ffs; Synchronous sequential circuits, finite-state machine (FSM) model, Mealy and Moore machines, synthesis of synchronous sequential circuits**.**

[7L]

Module 4 (Sequential circuit Design): Minimization and state assignment, incompletely specifiedm/c's; Counters and shift registers; asynchronous sequential circuit design.

[8L]

Module 5 (Algorithmic State Machines (ASM)): Design steps from algorithmic flowcharts todata path – controller partitioned ASMs --- Data path synthesis, ALU and status detection circuits,

[8L]

Text Books:	
1	H. Taub and D. Schilling, Digital Integrated Electronics, McGraw-Hill
2	Z. Kohavi, Switching and Finite Automata Theory, Tata McGraw-Hill.
Reference Books:	
1	Randy H. Katz and Gaetano Borriello, Contemporary Logic Design, Prentice Hall of India.
2	Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, Tata McGraw-Hill.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand** the fundamental concepts and techniques used in digital electronics.	**PO1, PO2, PO3, PO4, PSO3**
CO2	**Explain** the working mechanism and design guidelines of different combinational and sequential circuits.	**PO1, PO2, PO3, PO4, PSO3**
CO3	**Classify** different logic families, semiconductor memories and PLD devices.	**PO1, PO2, PO3, PO4, PO5 PSO3**
CO4	**Illustrate** reduction of logical expressions using Boolean algebra and k-map.	**PO1, PO2, PO3, PO4, PO5, PSO3**
CO5	**Implement** Digital Logic circuits using VHDL and functions using logic gates.	**PO1, PO2, PO3, PO4, PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME11014	Prof. Core- IX (Digital System Design)	3	3	3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11015	Prof. Core- X (Biomedical Instrumentation – I)	L	T	P	C
Version 1.0	**Contact Hours –**	3	0	0	3
Pre-requisites/Exposure	Knowledge of analog & digital electronics				
Co-requisites	--				

Course Objectives:

1. To familiarize students with various aspects of measuring electrical parameters from living body.
2. To introduce students with the characteristics of medical instruments and related errors.
3. To illustrate various types of amplifiers used in biomedical instruments.
4. To familiarize students with biomedical recorders.
5. To introduce students with patient monitoring system & its characteristics.

Course Outcomes:

After completion of this course, students will be able to –

CO1. Describe and characterize the sources of biomedical signals and needs of using biomedical instruments & their limitations.
CO2. Understand & describe pc based medical instrumentation & regulation of medical devices.
CO3. Describe and characterize medical instruments as per their specifications, static & dynamic characteristics and understand data acquisition system.
CO4. Describe, analyze, characterize and design Bio-amplifiers and various medical recording systems & their components.
CO5. Understand and describe patient monitoring systems and its necessity in healthcare system.

Course Description

It is a core course for all UG Biomedical Engineering students. This course includes the understanding of various aspects of measuring electrical parameters from living body and pc based medical instrumentation & regulation of medical devices and data acquisition from them. This course also intends to familiarize students with patient monitoring system & its characteristics.

Course Content

Module 1: Introduction to Biomedical Instrumentation: The age of biomedical engineering,Development of biomedical instrumentation, Biometrics, Introduction to the main-instrument system, Components of the main instrument system, Physiological Systems of the body, Problems encountered in measuring a living system, Design for bio-medical problems, diagnosis of disease and therapeutic applications.

Module 2: Types of Instruments: Resistive-, capacitive-, inductive-, piezoelectric-, Hall Effect sensors and associated signal conditioning circuits; Optical sources and detectors: LED, Photo-diode, p-i-nandavalanchephotodiode (APD), light dependent resistor and their characteristics; basics of magnetic sensing; Interferometer: applications in metrology; basics of fiber optic sensing. Basics of LASERs.

Module 3: Sources of Bioelectric potentials, Transducers and Electrodes: Resting and Action Potentials, Propagation of Action Potentials, Biochemical Transducers, The transducer and transduction principles, Active transducers, Passive transducers, Transducers for biomedical applications, The Bioelectric Potentials

Electrode theory, Bio Potential Electrodes, Study of various types of electrodes used in ECG, EEG, ENG, EOG and EMG, Measurement of ECG, EEG, ENG, EOG and EMG signals along with their diagnostic applications.

Module 4: Basic Instrumentation system for Bio signals: Design of a differential Bio potential Amplifier, Instrumentation amplifier; Transfer function representation; Filters; Frequency response and noise reduction; Frequency aliasing. A to D conversion and Computer based instrumentation, Instrumentation schemes of ECG, EEG, EMG, EOG, and ENG and their functional circuits.Performance evaluation and testing by simulation techniques.Specifications

Text Books:

1 Khandpur R.S., Hand book of Biomedical Instrumentation, TMH, 2003.
2 Tompkins, Biomedical Digital Signal Processing.
Leslie Cromwell**,** Fred J**.** Weibell**,** Pub**:** Erich A**.** Pfeiffer**.** Biomedical Instrumentation and Measurements**.**

Reference Books:

1 Carr & Brown, Introduction to Biomedical Equipment, Pearson Education, 2005.
2 Webester J.G., Medical Instrumentation, 3rd Edition, John Wiley,1997
3 Bio medical Engineering System By Manfred Clyner, John H. Milsum (McGrawHill)
4 Biomedical Signal Analysis – A Case Study Approach By Rangaray M. Rangayyan, (John Wiley and SonsInc)
5 Christensen's physics of Diagnostic Radiology by Thomas S. Curry,JumerE. Dowdey, Robert C. Murry.
6 Medical Instrumentation Haughton by John C**.** Webster (Mifflis Co**.** BostonUSA).
7 Bio-Medical Instrumentation – Dr. M. Arumugam, Anuradha Agencies, 2005

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Describe** and characterize the sources of biomedical signals and needs of using biomedical instruments & their limitations.	**PO1, PO3, PO4, PSO2, PSO3**
CO2	**Understand** & describe pc based medical instrumentation & regulation of medical devices.	**PO1, PO3, PO4, PO5PSO2, PSO3**
CO3	**Describe** and characterize medical instruments as per their specifications, static & dynamic characteristics and understand data acquisition system.	**PO1, PO3, PO4, PSO2, PSO3**
CO4	**Describe**, analyze, characterize and design Bio-amplifiers and various medical recording systems & their components.	**PO1, PO3, PO4, PO5, PSO2, PSO3**
CO5	**Understand** and describe patient monitoring systems and its necessity in healthcare system.	**PO4, PO5, PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11015	Prof. Core- X (Biomedical Instrumentation – I)	3		3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11035	Digital design & Manufacturing process	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Linear algebra, Discrete Mathematics, Probability, Statistics, Data Structure				
Co-requisites	Any one of high-level programming language (such as C++, C#, Java, Python or equivalent)				

Course Objective

1. To use computer-aided design and manufacturing techniques in industrial applications
2. To provide an analytical and critical framework to support fresh thinking in design and manufacturing
3. To help discover new creative uses of advanced manufacturing and design technologies
4. To give an understanding of the scope and limitations of digital applications in design and manufacturing
5. To develop business and entrepreneurial skills in working with digital manufacturing technologies

Course Outcomes

After completing the course, the student will be able to

CO1. Use computer-aided design and manufacturing techniques in industrial applications
CO2. Provide an analytical and critical framework to support fresh thinking in design and manufacturing
CO3. Help discover new creative uses of advanced manufacturing and design technologies
CO4. Give an understanding of the scope and limitations of digital applications in design and manufacturing
CO5. Develop business and entrepreneurial skills in working with digital manufacturing technologies

Course Description

This course examines a variety of digitally-controlled manufacturing processes that convert computer models directly into physical objects. Topics include: Additive manufacturing processes, CNC, Sheet cutting processes, Numerical control, Generative and algorithmic design. Topology Optimization, Broader social, economic, legal and business implications will also be reviewed.

Course Content

Unit I

Overview of digital manufacturing processes

1. What makes a manufacturing process "digital"
2. The 10 disruptive principles of digital manufacturing processes

Unit II

Additive Manufacturing processes – Engineering polymers, metals, ceramics

1. Stereolithography
2. Selective Laser Sintering
3. Fused Deposition Modeling
4. Polyjet
5. LENS
6. Layered object manufacturing

Unit III

Additive Manufacturing processes and Material properties

1. Electronic Materials
2. Bioprinting
3. Food Printing
4. Mechanical properties of printed materials
5. Post processing
6. Empirical and data-driven models

Unit IV:

CNC

1. Mill
2. Lathe

Unit V

2D Cutting

1. Laser Cutting
2. Plasma Cutting
3. Waterjet

Unit VI

Programmable Assembly

1. Digital Assembly
2. Digital Bending

Unit VII

Fundamentals of geometric representations for digital manufacturing

1. Solid representations
2. Boundary representations
3. Function representations
4. Voxel representations

Unit VIII

Algorithmic design for digital manufacturing

1. Parametric Models
2. Vibrational Geometry
3. Generative models
4. Topology optimization

Unit IX
Machine Control
1. Gantry positioning approaches
2. STL/AMF Slicing

Unit X
Broader impacts
1. Safety, Liability and intellectual property
2. Environmental impact
3. On-demand fabrication models and mass customization

Text Books:

Reference Books:

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Use computer-aided design and manufacturing techniques in industrial applications	**PO6, PO11, PSO3**
CO2	Provide an analytical and critical framework to support fresh thinking in design and manufacturing	**PO6, PO11, PSO3**
CO3	Help discover new creative uses of advanced manufacturing and design technologies	**PO6, PO8, PO11, PSO3**
CO4	Give an understanding of the scope and limitations of digital applications in design and manufacturing	**PO6, PO8, PO11, PSO3**
CO5	Develop business and entrepreneurial skills in working with digital manufacturing technologies	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12012	Digital design & Manufacturing process						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11017	Prof. Elective- I (Bio-fluid Mechanics)	L	T	P	C
Version 1.0	**Contact Hours –**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

1. To understand basic physical properties of fluids and evaluate force and pressure balances acting on fluid.
2. To understand hemodynamics and fluid dynamics measurement techniques in human circulation system
3. To understand transport in internal organs and in external field.
4. To understand Computational Analysis Techniques and to evaluate and design biofluid mechanics problems

Course Outcomes:

After completion of this course, students will be able to –

CO1. Understand basic physical properties of fluids and evaluate force and pressure balances acting on fluid.
CO2. Able to solve classic flow models and analytically approach and solve fluid flow problems
CO3. Understand physiology of the human circulation system.
CO4. Apply fluid mechanics to blood flow models.
CO5. Evaluate and design biofluid mechanics problems

Course Description

This course explores fluid mechanics in the context of the human circulatory system. Principal equations are derived from differential analysis of fluid flow, and models of characteristic flow conditions are fully analyzed. Biofluid mechanics, vessel biomechanics, and hemodynamic analysis of the circulation system will also be discussed.

Course Content

Unit 1: Basics of fluid mechanics: Properties of Newtonian and non-Newtonian fluids; field approach; control volume; Reynolds' transport theorem; principles of continuity, conservations of mass, energy and momentum and their applications; laminar and turbulent flows and boundary layer; dimensional analysis and similarity; unsteady flow and non- uniform geometric models.

Unit 2: Hemodynamics: Rheological properties of blood and, effects of blood viscosity variation; hemodynamics; Casson equation; blood flow in microcirculation; blood flow in vascular and heart diseases; fluid dynamics measurement techniques relevant to blood flow.

Unit 3: Transport in internal organs: Diffusion processes in human systems; gas exchange in the pulmonary system; Pulmonary flow in diseased condition; blood flow and sodium transport in the kidney; transport in digestive system; fluid dynamics in vestibular system; intraocular fluid flow.

Unit 4: Transport in external field: Fluid dynamics of swimming, bacterial swimming, maneuvering and propulsion of underwater creatures; Fluid mechanics of insect and bird flight; theory of lift; concept of drag reduction.

Unit 5: Computational Analysis Techniques: Finite volume method (FVM); Central differencing scheme; Upwind differencing scheme; Hybrid differencing scheme; Properties of discretisation schemes: Conservativeness; Boundedness; Transportiveness; FVM for steady state diffusion problems; Steady one-dimensional convection and

diffusion; Power-law scheme; The quadratic upstream interpolation for convective kinetics (QUICK) scheme.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand** basic physical properties of fluids and evaluate force and pressure balances acting on fluid.	**PO3, PO4, PO5 PSO2, PSO3**
CO2	**Able** to solve classic flow models and analytically approach and solve fluid flow problems	**PO3, PO4, PO5 PSO2, PSO3**
CO3	**Understand** physiology of the human circulation system.	**PO3, PO4, PO5 PSO2, PSO3**
CO4	**Apply** fluid mechanics to blood flow models.	**PO3, PO4, PO5 PSO2, PSO3**
CO5	**Evaluate** and design biofluid mechanics problems	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11017	Prof. Elective- I (Bio-fluid Mechanics)			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11036	Cancer Biology	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Linear algebra, Discrete Mathematics, Probability, Statistics, Data Structure				
Co-requisites	--				

Course Objective

1. To understand the common cellular and molecular mechanisms that are deregulating cancerous cells
2. To learn about how does cancerous cell regulation contribute to the development of cancer.

Course Outcomes

After completing the course, the student will be able to
CO1. Understand gene mutation play in the development of cancer
CO2. Understand the common cellular and molecular mechanisms that are deregulating cancerous cells
CO3. Learn about how does cancerous cell regulation contribute to the development of cancer

Course Description

Through this course students will be able to play a critical role in enhancing clinical decision-making with machine learning to build the treatments of the future. They will learn to build, evaluate, and integrate predictive models that have the power to transform patient outcomes. The course will begin by classifying and segmenting 2D and 3D medical images to augment diagnosis and then move on to modeling patient outcomes with electronic health records to optimize clinical trial testing decisions. Finally, build an algorithm that uses data collected from wearable devices to estimate the wearer's pulse rate in the presence of motion.

Course Content

Unit I
Fundamentals of Cancer Biology
1. Regulation of Cell cycle
2. Mutations that cause changes in signal molecules effects on receptor
3. signal switches tumour suppressor genes
4. Modulation of cell cycle-in cancer
5. Different forms of cancers
6. Diet and cancer.

Unit II
Principles of Carcinogenesis
1. Chemical Carcinogenesis
2. Metabolism of Carcinogenesis

3. Natural History of Carcinogenesis
4. Targets of Chemical Carcinogenesis
5. Principles of Physical Carcinogenesis
6. X-Ray radiation
7. Mechanism of radiation Carcinogenesis.

Unit III
Principles of Molecular Cell Biology of Cancer
1. Oncogenes
2. Identification of Oncogenes
3. Retroviruses and Oncogenes
4. detection of Oncogenes
5. Growth factor and Growth factor receptors that are Oncogenes
6. Oncogenes/ Proto Oncogenes activity
7. Growth factors related to transformations.

Unit IV:
Principles of Cancer Metastasis
1. Clinical significances of invasion
2. heterogeneity of metastatic phenotype
3. Metastatic cascade
4. Basement membrane disruption
5. Three step theory of invasion
6. Proteinases and tumour cell invasion.

Unit V
New Molecules for Cancer Therapy
1. Different forms of therapy
2. Chemotherapy- Radiation Therapy Detection of Cancers
3. Prediction of aggressiveness of Cancer
4. Advances in Cancer detection.
5. Bioinformatics and Cancer

Text Books:

1. Weinberg, Robert A. The Biology of Cancer, Second Edition. NewYork: GarlandScience, 2013

Reference Books:

1. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, Lauren Pecorino
2. Principles of Cancer Biology, Klein smith.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand gene mutation play in the development of cancer	**PO6, PO11, PSO3**
CO2	Understand the common cellular and molecular mechanisms that are deregulating cancerous cells	**PO6, PO11, PSO3**
CO3	Learn about how does cancerous cell regulation contribute to the development of cancer	**PO6, PO8, PO11, PSO3**
CO4		**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12012	Cancer Biology						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

ECE11017	Foundation on Artificial Intelligence and Machine Learning	L	T	P	C
Version 1.0	Contact Hours - 30	2	0	0	2
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

1. To equip students with a solid foundation in linear algebra and optimization techniques, enabling them to understand and apply mathematical concepts crucial for data science and machine learning.
2. To introduce students to the essentials of inferential statistics, including probability theory, probability distributions, hypothesis testing, and their practical implementation in Python, fostering the ability to perform rigorous statistical analysis.
3. To provide a comprehensive refresher on Python programming, emphasizing data structures, functional programming, and the use of essential libraries such as NumPy and Pandas for data analysis, manipulation, and visualization.
4. To offer a foundational understanding of artificial intelligence and machine learning, covering their definitions, historical evolution, current trends, and real-world applications, preparing students for further study and practical work in these fields.

Course Outcomes

On completion of this course, the students will be able to

CO1: Demonstrate a comprehensive understanding of key concepts in linear algebra and optimization techniques.

CO2: Ability to conduct inferential statistical analysis, including understanding and applying probability distributions.

CO3: Develop strong programming skills in Python, with a focus on using key libraries like NumPy and Pandas for data analysis, manipulation, and visualization.

CO4: Acquire foundational knowledge in artificial intelligence (AI) and machine learning (ML).

Catalog Description:

This course provides a comprehensive introduction to the foundational concepts and skills required for data science and machine learning. Students will develop proficiency in linear algebra, optimization techniques, and inferential statistics and will apply these concepts using Python programming. The course emphasizes practical data manipulation and visualization using essential Python libraries like NumPy and Pandas. Additionally, students will gain a foundational understanding of artificial intelligence (AI) and machine

learning (ML), exploring their historical context, current trends, and real-world applications. By the end of the course, students will be equipped with the knowledge and skills to tackle complex engineering problems and to engage in advanced studies in AI and ML.

Course Content

Unit I: 8 lecture hours

Mathematical Foundations:

Linear Algebra: Vectors, Matrices, Norms, Subspaces, Projections, SVD, EVD, Derivatives of Matrices, Vector Derivative Identities, Least Squares

Optimization: Gradient Descent, Second Derivative Test, Constrained Optimization, KKT

Unit II: 8 lecture hours

Statistics Essentials:

Inferential Statistics: Probability, Probability Distributions, and the Central Limit Theorem.

Hypothesis Testing: Definition and importance, Components of hypothesis testing: the null hypothesis and alternative hypothesis, steps involved in hypothesis testing. P-Value, different types of tests, and implementation in Python.

Unit III: 10 lecture hours

Programming Refresher:

Introduction to Python: Understanding the structure of Python, Data Structures like lists, tuples, and dictionaries. Functional Programming in Python.

Python for Data Science: The 2 most important libraries of Python – NumPy and Pandas. NumPy and Pandas are essential for Data Analysis, cleaning, and most of the core Data Science work.

Data Visualization in Python: plotting graphs and trends using Python.

Unit IV: 4 lecture hours

Introduction to Artificial Intelligence (AI) and Machine Learning (ML): Definition and Scope of AI and ML, Historical overview and current trends, Applications and impact of AI and ML in various industries

Text Books

1. "Introduction to Linear Algebra" by Gilbert Strang, published by Wellesley-Cambridge Press.
2. "Convex Optimization" by Stephen Boyd and Lieven Vandenberghe, published by Cambridge University Press.
3. "Statistics for Engineers and Scientists" by William Navidi, published by McGraw-Hill Education.
4. "Python Crash Course" by Eric Matthes, published by No Starch Press.
5. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, published by Pearson.
6. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy, published by The MIT Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Demonstrate** a comprehensive understanding of key concepts in linear algebra and optimization techniques.	**PO1, PO2, PO5**
CO2	**Ability to conduct** inferential statistical analysis, including understanding and applying probability distributions.	**PO1, PO2 PO4, PO5**
CO3	**Develop** strong programming skills in Python, with a focus on using key libraries like NumPy and Pandas for data analysis, manipulation, and visualization.	**PO1, PO5, PO10, PO12**
CO4	**Acquire** foundational knowledge in artificial intelligence (AI) and machine learning (ML).	**PO1, PO3, PO5, PO7, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO1	PSO2
PHY11201	Foun-dation Course on Artificial Intelligence and Machine Learning	3	3		3	2		2			2		2	3	3

1=weakly mapped

2= moderately mapped

3=strongly mapped

BME11018	Design of Medical Devices & Implants	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	-				
Co-requisites	--				

Course Objectives

1. To provide a comprehensive overview of biosensors, medical devices, and implants, focusing on bioelectronics and material compatibility.
2. To study the components, working principles, and various types of biosensors such as electrochemical, optical, and thermometric sensors.
3. To introduce the principles of MEMS (Micro-Electro-Mechanical Systems) and NEMS (Nano-Electro-Mechanical Systems) technology, focusing on microfabrication processes and material properties.
4. To impart knowledge on micro-device fabrication technologies, including lithography, micromachining, and micro-fluidics.
5. To study the different types of implant devices, focusing on their design, mechanical, and electromagnetic properties, and their applications in diagnostics and drug delivery..

Course Outcomes

On completion of this course, the students will be able to

CO1: Demonstrate a solid understanding of medical devices, biosensors, and the fundamentals of bioelectronics, including material selection and compatibility.

CO2: Analyze and evaluate various types of biosensors, understanding their working principles and applications in healthcare.

CO3: Apply MEMS and NEMS principles in designing and fabricating micro and nano-electronic devices for medical applications.

CO4: Proficient in using advanced techniques such as lithography, micromachining, and etching to design and fabricate medical devices at the micro-scale.

CO5: Designing and proposing innovative medical solutions using implant devices in fields such as diagnostics, surgery, and drug delivery.

Catalog Description:

The *Design of Medical Devices & Implants* course provides an in-depth exploration of the principles and technologies involved in the development of medical devices and implants, with a focus on biosensors and bioelectronic systems.

Students will gain a comprehensive understanding of the materials, design, and fabrication processes required for creating effective and compatible medical devices. The course covers a range of topics, including the types and applications of biosensors, MEMS (Micro-Electro-Mechanical Systems) and NEMS (Nano-Electro-Mechanical Systems) technology, and implantable devices used in diagnostics, surgery, and drug delivery. By the end of the course, students will be equipped with the skills and knowledge needed to design, analyze, and innovate within the rapidly evolving field of medical devices and implants.

Course Content

Module I: 9 lecture hours

Overview of biosensors, medical devices and Implants. Fundamentals of bioelectronics, suitable materials, material compatibility and combinations, necessary and sufficient conditions

Module II: 8 lecture hours

Bioelectronic devices

Components and working principle of biosensor, Types of Biosensors – Electrochemical, amperometric, potentiometric, impedimetric, voltametric, piezoelectric, thermometric, optical, and FET based biosensors.

Module III: 5 lecture hours

MEMS Technology

Introduction to Microelectronics and Nanotechnology, Crystal structure and properties of silicon, crystal growth and epitaxy, thermal oxidation, impurity doping, MEMS & NEMS

Module IV: 5 lecture hours

Design, and fabrication technology

Lithography, Etching, MEMS material, Bulk micromachining, Surface micromachining, Micro-actuator, electrostatic actuation, Micro-fluidics.

Module V: 7 lecture hours

Implant devices types and medical applications, Mechanical, Electromagnetic, Magnetic, and Optical sensors and devices, Application in Diagnostic, Surgical and drug delivery.

Text Books

3. Turner, A.P.F., Karube, I., and Wilson G.S., Biosensors - Fundamentals and Applications, Oxford University Press (2008).

4. S. M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, John Wiley and Sons, (2007).

Reference Books

1. Gardner, J.W., Microsensors, Principles and Applications, John Wiley and Sons (1994).

2. Victor C. Yang, Biosensors and Their applications, Springer (2000)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Demonstrate** a solid understanding of medical devices, biosensors, and the fundamentals of bioelectronics, including material selection and compatibility.	**PO1, PO3, PO4, PSO2, PSO3**
CO2	**Analyze and evaluate** various types of biosensors, understanding their working principles and applications in healthcare.	**PO1, PO3, PO4, PO5PSO2, PSO3**
CO3	**Apply** MEMS and NEMS principles in designing and fabricating micro and nano-electronic devices for medical applications.	**PO1, PO3, PO4, PSO2, PSO3**
CO4	**Proficient** in using advanced techniques such as lithography, micromachining, and etching to design and fabricate medical devices at the micro-scale.	**PO1, PO3, PO4, PO5, PSO2, PSO3**
CO5	**Designing** and proposing innovative medical solutions using implant devices in fields such as diagnostics, surgery, and drug delivery.	**PO4, PO5, PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11018	Design of Medical Devices & Implants	3		3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11033	Prof. Elective- V (Modelling and simulation of biomedical systems)	L	T	P	C
Version 1.0	**Contact Hours – 40**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To describe general methods and principles for modelling and simulating a system.
2. To apply these principles when designing mathematical models for realistic systems.
3. To implement and use computer-based modelling and simulation for studying relevant problems.
4. To apply these methods and principles for modelling of systems and processes relevant for diagnostics, treatment and as well as different physiological processes.
5. To assess the pertinency and usability for diverse models and simulation procedures.

Course Outcome

After completion of the course the students will be able to

CO1. Describe general methods and principles for modelling and simulating a system.
CO2. Apply these principles when designing mathematical models for realistic systems.
CO3. Implement and use equivalent circuit model for studying relevant problems within the field of biomedical engineering.
CO4. Apply these methods and principles for modelling of systems and processes relevant for diagnostics, treatment and as well as different physiological processes.
CO5. Critically evaluate the applicability and usability for different models and simulation techniques.

Course Description

The purpose of the course is to introduce and apply methods of general interest in modelling and simulations. The course aims at giving a mix between theory and hands on practice in relevant application areas. The focus is to study methods and applications that are of relevance in biomedical engineering within diagnostic and therapeutic applications as well as for physiological processes.

Course Content

Module 1: Approaches to modelling

The technique of mathematical modelling, classification of models, characteristics of models.Purpose of physiological modelling and signal analysis, linearization of nonlinear models. Time invariant and time varying systems for physiological modelling
[15L]

Module 2: Equivalent circuit model

Electromotive, resistive and capacitive properties of cell membrane change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of thewhole neuron. Huxley model of isotonic muscle contraction, modelling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis.
[15L]

Module 3: Physiological modelling

Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop, and Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria.

[15L]

Text Books:	
1	Endarle, Blanchard & Bronzino, Introduction to Biomedical Engg. , Academic press..
2	Suresh. R. Devasahayam, Signals & Systems in Biomedical Engineering, Kluwer Academic/ Plenum Publishers.
3	V.Z. Marmarelis, Advanced methods of physiological modeling, Plenum Press
Reference Books:	
1	J. Candy, Signal Processing: The Model Based approach, Mc. Graw Hill.
2	L.Stark, Neurological Control System, Plenum Press
3	R.B. Stein, Nerve and Muscle, Plenum Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Describe** general methods and principles for modelling and simulating a system	**PO1, PO2, PO8, PO12, PSO3**
CO2	**Apply** these principles when designing mathematical models for realistic systems**.**	**PO1, PO3, PO8, PO11, PSO3**
CO3	**Implement** and use equivalent circuit model for studying relevant problems within the field of biomedical engineering.	**PO1, PO2, PO8, PO12, PSO3**
CO4	**Apply** these methods and principles for modelling of systems and processes relevant for diagnostics, treatment and as well as different physiological processes	**PO1, PO3, PO8, PO11, PSO3**
CO5	**Critically evaluate** the applicability and usability for different models and simulation techniques.	**PO1, PO3, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11033	Prof. Elective-V (Modelling and simulation of biomedical systems)	3	3	3					3			3	3			3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

ECE11020	**Introduction to Machine Learning**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

1. To introduce students to the fundamental principles and techniques of machine learning.
2. To provide students with hands-on experience in implementing and evaluating various machine learning algorithms.
3. To familiarize students with advanced topics in machine learning and their applications in real-world scenarios.
4. To equip students with the necessary skills to tackle complex problems in domains such as robotics, speech/audio processing, IoT, and healthcare using machine learning techniques.

Course Outcomes

On completion of this course, the students will be able to

CO1: Understand fundamental machine learning concepts, including learning definition, evaluation methods, dataset handling, and feature sets.
CO2: Apply supervised, unsupervised, and reinforcement learning techniques in practical scenarios.
CO3: Implement and assess classification and regression algorithms like KNN, Linear Regression, and SVM.
CO4: Utilize clustering and dimensionality reduction techniques such as K-means clustering, PCA, and LDA.
CO5: Explore advanced machine learning topics like deep learning, NLP, CV, and analyse case studies across various domains.

Catalog Description:

This course offers a comprehensive introduction to machine learning, covering foundational concepts and practical applications. Students will learn about supervised, unsupervised, and reinforcement learning techniques and gain proficiency in implementing algorithms like KNN, Linear Regression, and SVM. Through hands-on exercises and case studies, students will explore advanced topics such as deep learning, NLP, and CV, and analyse their applications in domains like robotics, IoT, and healthcare. By the end of the course, students will be equipped with the skills to apply machine learning algorithms to solve real-world problems effectively.

Course Content

Unit I: **4 lecture hours**

Introduction:

What Is Machine Learning, How Do We Define Learning, How Do We Evaluate Our Networks, How Do We Learn Our Networks, What are datasets and how to handle them, Feature sets, Dataset division: test, train and validation sets, cross-validation.

Unit II: **10 lecture hours**

Basics of Machine Learning:

Applications of Machine Learning, processes involved in Machine Learning, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, Real life examples of Machine Learning

Unit III: **11 lecture hours**

Supervised Learning:

Classification and Regression: K-Nearest Neighbor, Linear Regression, Logistic Regression, Support Vector Machine (SVM), Evaluation Measures: SSE, MME, R2, confusion matrix, precision, recall, F-Score, ROC-Curve

Unit IV: **10 lecture hours**

Unsupervised Learning:

Introduction to clustering, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partitional Clustering - K-means clustering.

Unit V: **10 lecture hours Dimensionality reduction techniques:** PCA, LDA, ICA. Introduction to Deep Learning, Gaussian Mixture Models, Natural Language Processing, Computer Vision.

Implement basic ML models like SVM, KNN, K-Means, Logistic Regression, and Linear Regression using Python

Case studies on ML: Robotics and automation/ Speech and audio processing/ Signal processing and pattern recognition/Internet of Things (IoT) applications/ Wireless Communication and Networking/ Embedded Systems and Edge Computing/ Circuit Design and Optimization/ Energy Efficiency and Power Management/ Healthcare/ Medical Diagnostics.

Text Books

1. "Machine Learning: A Probabilistic Perspective" by Kevin Murphy (MIT Press, 2012)
2. "The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, Jerome Friedman (Springer, 2009)
3. "Pattern Recognition and Machine Learning" by Christopher Bishop (Springer, 2007)
4. "Machine Learning" by Rajiv Chopra (Khanna Publishing House, 2018

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs

	Course Outcomes (COs)	Mapped Program Outcomes
CO1	**Understand** fundamental machine learning concepts, including learning definition, evaluation methods, dataset handling, and feature sets.	**PO1, PO2, PO5**
CO2	**Apply** supervised, unsupervised, and reinforcement learning techniques in practical scenarios.	**PO1, PO2 PO5, PO9**
CO3	**Implement and assess** classification and regression algorithms like KNN, Linear Regression, and SVM.	**PO1, PO2, PO4, PO5**
CO4	**Utilize** clustering and dimensionality reduction techniques such as K-means clustering, PCA, and LDA.	**PO1, PO2, PO4, PO5**
CO5	**Explore** advanced machine learning topics like deep learning, NLP, CV, and analyse case studies across various domains.	**PO1, PO2, PO5, PO6, PO10**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems
Course Code	Course Title	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1
ECEXXX XX	Intro-duction to Machine Learning	3	3		2	3	2			2	2			3

1=weakly mapped

2= moderately mapped

3=strongly mapped

BME11019	Prof. Core- VIII Lab (Biomechanics Lab)	L	T	P	C
Version 1.0	**Contact Hours –**	2	0	0	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

1. To perform Mechanical characterization & Hardness testing of biomaterials
2. To measure Surface roughness & haemocompatibility of biomaterials
3. To analyse Stress Strain of knee and elbow joints
4. To determine mechanical properties of muscles, cartilages, and bone
5. To build simple mechanical models in CAD software.

Course Outcomes:

After completion of this course, students will be able to –

CO1. Perform Mechanical characterization & Hardness testing of biomaterials
CO2. Measure Surface roughness & haemocompatibility of biomaterials
CO3. Stress Strain analysis of knee and elbow joint
CO4. Determination of mechanical properties of muscles, cartilages, and bone
CO5. Building simple mechanical models in CAD software.

Course Description

It is a core course for all UG Biomedical Engineering students. This course will provide basic hands-on laboratory experiments in Biomaterials & Biomechanics.

Course Content

List of experiments:

1. Measurement of range of movements of different joints using goniometer
2. Demonstration of gait cycle.
3. Analysis of gait using computational models.
4. Respiratory mechanics
5. Handling EMG
6. Determination of mechanical properties of muscles using universal testing machine
7. Determination of mechanical properties of cartilages using universal testing machine
8. Determination of mechanical properties of bone using universal testing machine
9. Building simple mechanical models in CAD software.
10. Analysis of the exported CAD model in FEA platform.
11. Analysis of stress-strain distribution for knee joint using FEA.
12. Analysis of stress-strain distribution for elbow joint using FEA.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Perform** Mechanical characterization & Hardness testing of biomaterials	**PO3, PO4, PO5 PSO2, PSO3**
CO2	**Measure** Surface roughness & haemocompatibility of biomaterials	**PO3, PO4, PO5 PSO2, PSO3**
CO3	Stress Strain **analysis** of knee and elbow joint	**PO3, PO4, PO5 PSO2, PSO3**
CO4	**Determination** of mechanical properties of muscles, cartilages, and bone	**PO3, PO4, PO5 PSO2, PSO3**
CO5	**Building** simple mechanical models in CAD software.	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11019	Prof. Core-VIII Lab (Biomechanics Lab)			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12020	Prof. Core- IX (Digital System Lab)	L	T	P	C
Version 1.0	**Contact Hours – 45**	0	0	3	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

1. To understand the various basic logic gates
2. To design and implement the various combinational circuits
3. To design and implement sequential circuits
4. To design and implement ASM devices

Course Outcomes:

After completion of this course, students will be able to –

CO1. Implement simplified combinational circuits using basic logic gates

CO2. Understand the design and implement switching functions in combinational logic circuits

CO3. Implement sequential circuits like registers and counters

CO4. Implement sequential circuits using ASM devices

CO5. Simulate combinational and sequential circuits using HDL

Course Description

It is a core course for all UG Biomedical Engineering students. Topics covered will focus on the design of digital systems using combinational, sequential, and programmable logic devices. Techniques for logic design including asynchronous logic, physical world interfaces to digital systems, and system performance analysis methods will be studied.

Course Content

List of Experiments:

1. **TTL and CMOS Gates:** Study the characteristics of TTL and MOS gates, Display of the characteristics on oscilloscopes.
2. **Combinational logic circuits:** Design and implementation of switching functions using minimization for both dnf and cnf; Design of decoders, multiplexor – demultiplexor, adder / subtractor, ALU, comparators, 7-segment LED display driver, etc
3. **Sequential Circuits:** D FF and JK FF state transition function verification, Implementation of JK master-slave FF using logic gates, Astable and monostableckt. using a 555 timer chip, Design of a 4 bit universal shift register with parallel load, shift-left and shift-right facility, Design of sequence generators and detectors, counters.
4. design of ASMs such as, traffic light controllers, vending machine, keyboard interface etc. (any one).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Implement** simplified combinational circuits using basic logic gates	**PO3, PO4, PO5 PSO2, PSO3**
CO2	**Understand** the design and implement switching functions in combinational logic circuits	**PO3, PO4, PO5 PSO2, PSO3**
CO3	**Implement** sequential circuits like registers and counters	**PO3, PO4, PO5 PSO2, PSO3**
CO4	**Implement** sequential circuits using ASM devices	**PO3, PO4, PO5 PSO2, PSO3**
CO5	**Simulate** combinational and sequential circuits using HDL	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12020	Prof. Core- IX (Digital System Lab)			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12021	Prof. Core- X Lab (Biomedical Instrumentation – I Lab)	L	T	P	C
Version 1.0	**Contact Hours –**	0	0	3	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

1. To understand and implement isolation techniques in designing biomedical instruments.
2. To design temperature and humidity sensing module and pressure measurement system
3. To measure and Analyze ECG and EEG waveforms in diagnostic point of views
4. To measure oxygen saturation and pulse rate.
5. To understand the evaluation of auditory function using different devices

Course Outcomes:

After completion of this course, students will be able to –

CO1. Understand and implement isolation techniques in designing biomedical instruments.
CO2. Design temperature and humidity sensing module and pressure measurement system
CO3. Measure and Analyze ECG and EEG waveforms in diagnostic point of views
CO4. Measure oxygen saturation and pulse rate.
CO5. Understand the evaluation of auditory function using pure-tone audiometer and spirometer

Course Description

It is a core course for all UG Biomedical Engineering students.

Course Content

Experiment List:

1. Designing of a temperature and humidity sensing module
2. Designing of pressure measurement system by using LVDT
3. Acquisition and analysis of ECG signal
4. Acquisition and analysis of EEG signal
5. Evaluation of auditory function using a pure-tone audiometer
6. Measurement of oxygen saturation and pulse rate using pulse oxymeter
7. BP measurement using sphygmomanometer and stethoscope
8. Evaluation of auditory function using spirometer

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand** and implement isolation techniques in designing biomedical instruments.	**PO3, PO4, PO5 PSO2, PSO3**
CO2	**Design** temperature and humidity sensing module and pressure measurement system	**PO3, PO4, PO5 PSO2, PSO3**
CO3	**Measure** and Analyze ECG and EEG waveforms in diagnostic point of views	**PO3, PO4, PO5 PSO2, PSO3**
CO4	**Measure** oxygen saturation and pulse rate.	**PO3, PO4, PO5 PSO2, PSO3**
CO5	**Understand** the evaluation of auditory function using pure-tone audiometer and spirometer	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12021	Prof. Core- X Lab (Biomedical Instrumentation – I Lab)			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

SEMESTER VI

BME11022	Prof. Core- XII (Measurements and Control Systems)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objectives

The student should be made to

1. To provide in-depth knowledge of the core principles, their experimental basis of measurement systems.
2. To enable students to acquire a concept and understanding of the theoretical and technical basis for biophysical measurement and systems.
3. This course is objected to impart knowledge on the fundamentals of Control systems engineering, its components and applications.

Course Outcomes

CO1. Students will have an overview about control systems and mathematical modeling of the system
CO2. The students will be able to impliment time response and frequency response of a system.
CO3. The students will be familiar with the basics of stability analysis of the system
CO4. The students will be aware of problem-solving techniques and designing aspects of the control system.

Course Description

Measurement and control systems (MCS) are such a group of software which use laboratory devices to obtain measurement data or to control e.g. production processes. Bugs in software can lead to variety of problems, from incorrect measurement data to device damages.

Course Content

Module 1:

Measurement: SI units, systematic and random errors in measurement, expression of uncertainty - accuracy and precision index, propagation of errors.

Module 2:

Introduction: Classification of systems, Basic concept of Control System, Classifications, Differential Equation & Transfer Function (Open Loop & Closed Loop), Feedback & Non-feedback System, Effect of Feedback on Gain, Stability, Sensitivity & Noise of the System.

[10L]

Module3:

Modeling: Mathematical Modeling of Electrical System & Mechanical System (Translational & Rotational

Mechanical System) Analogous System, Block Diagram Algebra, Developing Block Diagram from a Mathematical Model, SFG, Mason's Gain Formula, SFG from Block Diagram (SFG Terminology, Construction & Procedure), Problem Practice based on application of SFG to Control System.

[12L]

Module4:

Characterization of plants: Asymptotic and BIBO stability; Significance of poles and eigenvalues; Internal stability; Standard Test Signals (Step Input, Ramp Input, Parabolic Input & Impulse Input)**.** Time Response of 1st order & 2nd order System to the Test Signals, Type & Order of the System. Time Response Specifications, Generalized Error Co-efficient, Steady State Error & Design Specifications, Error Constants, Effect of adding Poles & Zeros to Transfer Function, Response with P, PI, PD & PID Controllers.

[15L]

Module 5:

Stability: The Concept of Stability, Necessary Condition for Stability, R-H Stability Criteria, Relative Stability Analysis, Application of R-H Criterion to Linear Control System, Root Locus Concept, Construction of Root Locus, Rules for the Construction of the Root Locus, Effect of adding Poles & Zeros to G(s) H(s), Determination of Gain from Root Locus.

[15L]

Module6:

Frequency Domain Analysis: Introduction, Correlation between Time & Frequency Response,Polar Plots, Bode Plots, Nyquist Stability Criteria, Stability Analysis & Relative Stability.

[08L]

Text Books:	
1	Control Systems by Smarjit Ghosh, Pearson, second Impression, 2013
2	Control System Engg, by I.J.Nagrath& M Gopal, New age international publication, 4th Edition,2011.
Reference Books:	
1	Automatic Control Systems by Benjamin C. Kuo, Prentice-Hall, 7th Edition, 2009.
2	Modern Control Engg. by K. Ogata PHI publication, 5th Edition, 2010.
3	Automatic control system by HasanSaeed, sixth revised edition 2008, S.K. Kataria& Sons.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**

CO1	Students will have an overview about control systems and mathematical modeling of the system	**PO1, PO2, PO12**
CO2	The students will be able to impliment time response and frequency response of a system.	**PO1, PO2, PO4**
CO3	The students will be familiar with the basics of stability analysis of the system	**PO1, PO2, PO3, PO4**
CO4	The students will be aware of problem-solving techniques and designing aspects of the control system	**PO1, PO2, PO4, PO5**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3

BME11022	Prof. Core- XII (Measurements and Control Systems)	3	3	3	3	3							3			

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11023	Prof. Core- XIII (Digital Image Processing)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics and basic knowledge of Computers				
Co-requisites	--				

Course Objectives

1. To become familiar with digital image fundamentals
2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
3. To learn concepts of degradation function and restoration techniques.
4. To study the image segmentation and representation techniques.
5. To become familiar with image compression and recognition methods

Course Outcomes

CO1. Understand the basics of digital image processing, such as digitization, sampling, quantization, and 2D transforms.

CO2. Familiar with smoothing, sharpening, and enhancement of an image.

CO3. Know different filtering techniques, including restoration.

CO4. Aware of the basics of segmentation, feature extraction, compression, and recognition methods for color models.

Course Description

For engineering course, Mathematics is the backbone. Students will be having good engineering skills if their idea for Mathematics is clear. In this course the focus will be to learn Mathematics in depth which will motivate students to grow their thinking ability for Engineering also. By knowing the theory student will be able to apply that successfully to all kind of problems of Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in all group activities (Problem solving, presentation etc.).

Course Content

Module 1:

Fundamentals of Image processing and Image Transforms:

Medical Image Representation: Pixels and voxels – algebraic image operations - gray scale and color representation. Image files formats- DICOM- other formats

Basic steps of Image processing system sampling and quantization of an Image: Basic relationship betweenpixels Image Transforms: 2D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.

[10L]

Module 2:

Image Processing Techniques: Image Enhancement, Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters, Frequency Domain methods - Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation. [10L]

Module 3:

Image Compression: Image compression fundamentals: coding Redundancy, spatial and temporal redundancy. Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards.

[15L]

Module 4:

Medical Image Analysis and Classification: Feature extraction and representation, feature and image classification – Statistical, Rule based, Neural Network approaches

Image Registration and Visualization: Rigid body visualization, Principal axis registration

[15L]

Text Books:	
1	"Digital Image Processing", Gonzaleze and Woods, 3 rdedition , Pearson.
2	"Handbook of image and video processing", Bovik, Alan C. Academic press, 2010.
3	Wolfgang Birkfellner, „Applied Medical Image Processing – A Basic course", CRC Press, 2011.
Reference Books:	
1	"Digital video Processing", M. Tekalp, Prentice Hall International.
2	"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", Chris Solomon, Toby Breckon, John Wiley & Sons.
3	AtamP.Dhawan, „Medical Image Analysis", Wiley Interscience Publication, NJ, USA 2003.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the basics of digital image processing, such as digitization, sampling, quantization, and 2D transforms.	**PO1, PO2**
CO2	Familiar with smoothing, sharpening, and enhancement of an image.	**PO1, PO2, PO4**
CO3	Know different filtering techniques, including restoration.	**PO1, PO2, PO3 PO4**
CO4	Aware of the basics of segmentation, feature extraction, compression, and recognition methods for color models	**PO1, PO2, PO4 PO5**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions

Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11023	Prof. Core- XIII (Digital Image Processing)	3	3	3	3	3										

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

Course Code: xxx	Troubleshooting and Quality Control of Medical Devices	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basic Knowledge of 12th Physics, Chemistry, Math and understanding of common medical devices.				
Co-requisites	--				

Course Objectives

5. Create a sound understanding of the working conduction of a biomedical device.
6. Create a sense of ordinary working and abnormal behaviour of a medical device.
7. To provide knowledge to students to enable them to troubleshoot the various equipment's used in hospitals.
8. Provide a working protocol for quality control assessment.
9. Prepare the students for handling situation inside a hospital working condition.

Course Outcomes

On completion of this course, the students will be able to

CO1. Maintain normal working medical device.
CO2. Recognize quality control issues with medical devices.
CO3. Resolve issues regarding the device if required.
CO4. Assess situations related to medical device quality control and based on the demand of the situation, can decide on the future steps to be taken

Catalog Description

By definition, the quality control process is both reactive, and product focused. In manufacturing, these processes occur during and after production, as well as before being shipped to end users. A quality control process tests individual products or batches of a product to confirm they are in-line with product expectations as well as free of flaws or defects. In medical device manufacturing,maintenance, quality control teams use various methods and metrics to root out nonconforming products. The three main areas of focus for any quality control process are:

Course Content

Module 1: (8 Hours)

Testing of Electrical Equipments AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing- Earthing –Earth wires - Earthing of appliances –contactor, relay testing– CT and PT, Panel wiring- Megger-Testing equipment and instruments.

Module 2: (7 Hours)

Testing of Electronic Components Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse.

Module 3: (8 Hours)

Testing of Surgical Equipment Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.

Module 4: (8 Hours) Troubleshooting of Equipments X-ray machines, Troubleshooting of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

Module 5: (7 Hours)

Life Cycle Management of Medical Equipment Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle. Case study.

Module 6: (7 Hours)

Reliability in medical devices: Need for reliability, Tools for reliability assurance, MTBF, MTTR, FMEA, Fault tree analysis, Markov method, cause failure analysis. Human errors in healthcare systems, human factors approach to reduce error, Quality assurance through regulatory compliance: ISO: 9000, FDA, IEEE, ASTM, UL, CE. Computerized Maintenance management system for medical equipment.

Text Books:

1. B.S. Dhillon, “Medical Device Reliability and Associated Areas”, CRC Press, UK, 2000.
2. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York,4thedition, 2008.
3. Keith Willson, Keith Ison, Slavik Tabakov, “Medical equipment management”, CRC Press, UK, 2014.

Reference Book:

1. Jenny Dooley,John Lehnert Virginia Evans, “Career Paths: Medical Equipment Repair”, Express Publishing, UK,2018
2. Shakti Chatterjee, Aubert Miller, “Biomedical Instrumentation systems”, Cengage Learning Technology & Engineering, 2010.

3. David Herres, “Troubleshooting and Repairing Commercial Electrical Equipment”, McGraw Hill Professional edition, 2013.
4. R. S. Khandpur, “Troubleshooting Electronic Equipment” 1st Edition, McGraw Hill, 2007.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Maintain normal working medical device. to	**PO1, PO2, PO3, PSO1**
CO2	Recognize quality control issues with medical devices.	**PO2, PO3, PO6, PSO1**
CO3	Resolve issues regarding the device if required.	**PO1, PO3, PO9, PO12, PSO1**
CO4	Assess situations related to medical device quality control and based on the demand of the situation, can decide on the future steps to be taken	**PO1, PO2, PO3, PO12, PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
xxxx	Troubleshooting and Quality Control of Medical Devices	3	2		3	2	2								

1=weakly mapped

2= moderately mapped

3=strongly mapped

Course Code: BME11027	Microfluidics and BioMEMS	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Basic Knowledge of 12th Physics, Chemistry, Math.				
Co-requisites	--				

Course Objectives

10. The objective of this course is to introduce the concept of miniaturization, the materials and methods for microfabrication
11. Provide knowledge on the principles of microfluidics and various biological applications of microfluidics.
12. Introduce biomedical MEMS devices to the students with the application.
13. Make the students aware of the future possibilities of Microfluidics and BioMEMS.

Course Outcomes

On completion of this course, the students will be able to

CO1. Students will be able to understand the basics in micro/nano fabrication, with a strong emphasis on fabrication methods of polymer-based BioMEMS devices.

CO2. Describe and explaining different techniques such as soft lithography, injection moulding, micro contact printing to name a few.

CO3. Identify and explain microfluidic components such as microvalve, micropump, and microfluidic channels that form the key functional blocks in Lab-on-a-Chip devices are introduced.

CO4. Familiarize themselves BioMEMS applications in separation, minimally invasive diagnosis tools, implantable devices, drug delivery, opto fluidics, and microsystems for cellular studies and tissue engineering

Catalog Description

Fundamentals and fabrication techniques of bio microelectromechanical systems (BioMEMS); technical issues and applications of biomedical microdevices; emerging BioMEMS and lab-on-a-chip technologies.

Course Content

Unit 1. Introduction to BioMEMS and Microsystems technology: (5 Lecture)

- Basics of sensors. (1 Lecture)

- Biochip Sensors & Microarrays (1 Lecture)
- Introduction to device Fabrication. (2 Lecture)
- Microfluidics (1 Lecture)

Unit 2. Sensing Technologies: (10 Lecture)

- Potentiometric and Amperometric sensors (7 Lecture)
  Electrochemistry basics, Nersnt Equation, Referencing of electrodes, Nicolskii

  Eisenmann method of evaluation of electrode potential, Debye Huckel Theory, Zeta Potential on electrode surfaces, Cyclic Voltametry, Ion selectivity analysis.

- Impedometric sensing, Optical Sensing (Fluorescence, phosphorescence, FRET, Visible range and IR sensing), Mechanical sensing etc. (2 Lecture)
- Introduction to Microfluidic Sensor design. (1 Lecture)

Unit 3. Microfluidics (10 Lectures)

- Fundamentals of fluid flow (1 lecture)
- Continuum mechanics at small scales, Derivation of Conservation of Mass and Conservation of Momentum equations, Scaling laws. (2 lectures)
- Low Reynold's no. flows, Entrance effects in micro-fluidic devices, Surface tension driven flows. (1 lecture)
- Electro-kinetic flows (3 lecture)
  Electrophoresis, Electro-osmosis, Dielectrophoresis, Streaming potential and Sedimentation potential,
- Micro-fluidics for internal flow control (micro-pumps and micro-valves, device building and characterization) (1 Lectures)
- Micromixer design and characterization, Micro-fluidics for life sciences and chemistry. (2 Lectures)

Unit 4. Introduction to Cell biology, DNA & Proteins for diagnostics: (10 Lectures)

- Basics of the cell, DNA and proteins (1 Lecture)
- Introduction to Polymerase chain reaction (PCR) (1 Lecture)
- Microchip PCR (1 Lecture)
- Design of micro-reactors (1 Lecture)
- Space domain and time domain PCR reactors (1 Lecture)

- Design of DNA microarrays (1 Lecture)
- DNA and protein sensing (1 Lecture)
- Protein structure (1 Lecture)
- Protein transcription and translation (Protein structure coding) (2Lecture)

Unit 5. Microelectronic-fabrication processes: (05 Lectures)

- Review of basic silicon processes (3 Lectures)

Introduction to microelectronic fabrication, Optical lithography, photo-resists,

Non optical lithography techniques, LIGA processes, **Design Considerations**, Vacuum science and plasmas, Etching techniques, Physical vapor deposition

(evaporation and sputtering), Chemical vapor deposition.

- Review of basic fabrication processes for polymers: (2 Lectures)

Polymer materials for micro-systems, Polymeric micromachining technology like softlithography, Bulk and surface micromachining, replication technologies, laser machining, micro-stereo lithography, micro-molding, Assembly and packaging of micro-systems, Biocompatibility of materials and processes.

Text Books:

1. M. Madou, "Fundamentals of Microfabrication: The Science of Miniaturization", 2nd Edition, CRC Press, ISBN: 0849308267
2. Albert Folch, "Introduction to BioMEMS", 1st Edition, CRC Press, ISBN: 9781439818398
3. Nam-Trung Nguyen and Steve Wereley, "Fundamentals and Applications of Microfluidics", 2nd Edition, Artech House, ISBN: 1580539726.

Reference Book:

1. Fundamentals of Microfabrication (Second Edition), Marc J. Madou, CRC press Taylor and Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL33487-2724, 2002.
2. BioMEMS Technologies and Applications, Edited by Wanjun Wang, Steven A. Soper, CRC press Taylor and Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL33487-2724, 2006.

3. Biomolecular sensing, processing and analysis, Rashid Bashir, Steve T. Werely, Mauro Ferrari, Springer Science and Business Media LLC, 233 Spring Street, New York, NY10013, USA, 2006.
4. Fundamentals and applications of Microfluidics, Nam-Trung Nguyen, Steve T. Werely, Artech house Inc., 685 Canton Street, Norwood, MA02062, 2002.
5. The Science and Engineering of Microelectronic Fabrication (Second Edition), Stephen A. Cambell, Oxford University Press, 198, Madison Avenue, New York 10016, 2001.
6. Molecular Biology of the Cell (fourth edition), Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Kate Roberts, Peter Walter, Garland Sand, Taylor and Francis group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL33487-2724, 2002.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Students will be able to understand the basics in to micro/nano fabrication, with a strong emphasis on fabrication methods of polymer-based BioMEMS devices.	**PO1, PO2, PO3, PSO1**
CO2	Describe and explaining different techniques such as soft lithography, injection moulding, micro contact printing to name a few.	**PO2, PO3, PO6, PSO1**
CO3	Familiarize themselves BioMEMS applications in separation, minimally invasive diagnosis tools, implantable devices, drug delivery, opto fluidics, and microsystems for cellular studies and tissue engineering.	**PO1, PO3, PO9, PO12, PSO1**
CO4	Identify and explain microfluidic components such as microvalve, micropump, and microfluidic channels that form the key functional blocks in Lab-on-a-Chip devices are introduced.	**PO1, PO2, PO3, PO12, PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
BME11027	Microfluidics and BioMEMS	3	2		3	2	2								

1=weakly mapped

2= moderately mapped

3=strongly mapped

Course Code: BME11032	Biofabrication	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	No specialized knowledge of biology is required. Students with a bio/medical, material chemistry or engineering background are encouraged.				
Co-requisites	--				

Course Objectives

(1) To provide insight in the opportunities of additive manufacturing technologies, micro/nano devices and 3D printing in biomedical applications.
(2) To provide the basics of 3D printing and additive manufacturing and devices used for biofabrication, and the introduction to 3D design.
(3) To Provide insight in the specific challenges encountered when translating 3D printing to biofabrication, such as the development of specific bio-inks and the required control over processing conditions.
(4) To provide state-of-the-art examples of how currently biofabrication is translated from bench towards the bedside.

Course Outcomes

On completion of this course, the students will be able to

CO1. Students will have an insight of 3D bioprinting and allied technologies in biomedical and pharmaceutical applications.
CO2. Provide the basics and mechanisms of 3D bioprinting, 3D design software, and 3D tissue/organ printing.
CO3. Explain and familiarize with various 3D bioprinting techniques used in biofabrication; processing of medical imaging data into printable CAD models, and fabricating models on a 3D bioprinter.
CO4. Realize the bio fabrication-based strategy from bench-to-bed to address a specific clinical problem; ethical issue related to biofabrication.

Catalog Description

Biofabrication is the method of fabricating biomedical structures using viable cells, biological molecules, and biomaterials. An advanced process like 3D bioprinting is a Biofabrication process, in which the deposition of natural material in a layer-by-layer fashion is performed to create 3D structures like tissues and organs.

Course Content

Unit 1: INTRODUCING THE PRINCIPLES, METHODS AND MATERIALS

Introduction:

(1) Opportunities & Challenges of 3D bioprinting & biofabrication in medical applications
(2) Additive manufacturing and rapid prototyping
(3) 3D Visualization and Imaging Technologies
(4) 3D Modeling and Design Methods
(5) 3D Manufacturing: Materials and Methods
(6) Core Principles and Physical Foundations underlying 3D Bioprinting
(7) Basic process of 3D bioprinting (problem, design, material selection, and object fabrication)
(8) Personalized medicine and clinical needs Reading assignment:

Unit 2: BASICS OF 3D BIOPRINTING AND BIOFABRICATION

(1) Biofabrication and 3D-Bioprinting Technologies and Tools
(2) Development of bioinks (bioprintable materials, from metals and ceramics to hydrogels)
(3) Medical imaging and imaging processing
(4) Biomodeling
(5) Blueprints (Digital models of tissues and organs)
(6) Bioprinters
(7) Technology platform and emerging trends in bioprinting
(8) Validating assays applied to printed products (9) Case studies Reading assignment:

Unit 3: APPLICATIONS OF 3D BIOPRINTING AND BIOFABRICATION

(1) Problem identification
(2) Applications in Lab-on-chip and Organ-on-chip (Brain-on-chip, Artery-on-a-chip, Lung-on-a-chip, Bone-on-a-chip, Liver-on-a-chip, Gut-on-a-Chip, etc.)
(3) Applications in prosthetics (e.g. Robohand)
(4) Applications in implants
(5) Applications in innovative bioactive research (6) Applications in regenerative medicine Reading assignment:

Unit 4: ISSUES RELATED TO 3D BIOPRINTING AND BIOFABRICATION

(1) Ethical and regulatory issues
(2) Intellectual property and patent landscape
(3) Future perspective in terms of bench research and hospital Reading assignment:

Text Books:

(1) Atala et al., Essentials of 3D Biofabrication and Translation. 1st edition, ISBN-13: 978-0128009727.

(2) 2. Zhang et al., 3D Bioprinting and Nanotechnology in Tissue Engineering and Regenerative Medicine. 1st edition, ISBN 9780128005477.
(3) 3. Forgacs et al., Biofabrication - Micro- and Nano-fabrication, Printing, Patterning and Assemblies, 1st Edition, ISBN 9781455728527

Reference:

(1) Derby B. Printing and prototyping of tissues and scaffolds. Science. 2012. 338:921-6.
(2) 2. Seliktar D. Designing cell-compatible hydrogels for biomedical applications. Science. 2012. 336:1124-8.
(3) 3. Murphy SV, Atala A. 3D bioprinting of tissues and organs. Nature Biotechnology. 2014. 32:773-85.
(4) 4. Pati F, Gantelius J, Svahn HA. 3D Bioprinting of Tissue/Organ Models. Angewandte Chemie International Edition. 2016.55:4650-65.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Students will have an insight of 3D bioprinting and to allied technologies in biomedical and pharmaceutical applications.	**PO1, PO2, PO3, PSO1**
CO2	Provide the basics and mechanisms of 3D bioprinting, 3D design software, and 3D tissue/organ printing.	**PO2, PO3, PO6, PSO1**
CO3	Explain and familiarize with various 3D bioprinting techniques used in biofabrication; processing of medical imaging data into printable CAD models, and fabricating models on a 3D bioprinter..	**PO1, PO3, PO9, PO12, PSO1**
CO4	Realize the bio fabrication-based strategy from bench-to-bed to address a specific clinical problem; ethical issue related to biofabrication.	**PO1, PO2, PO3, PO12, PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
BME110 32	Biofabricat ion	3	2		3	2	2								

1=weakly mapped

2= moderately mapped

3=strongly mapped

ECE11029	Introduction to Artificial Intelligence	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

1. Introduce students to the fundamental concepts of Artificial Intelligence (AI), including intelligent agents and problem-solving techniques.
2. Explore automated reasoning methods such as propositional and first-order logic, inference, and deduction.
3. Familiarize students with planning algorithms and reasoning under uncertainty, including probabilistic reasoning and belief networks.
4. Provide students with an understanding of various machine learning approaches, including inductive learning and neural networks.
5. Examine real-world case studies in AI applications across different domains to demonstrate the practical relevance of AI techniques.

Course Outcomes

On completion of this course, the students will be able to

CO1: Develop proficiency in understanding the principles of intelligent agents and problem-solving techniques in AI.
CO2: Apply automated reasoning methods, including propositional and first-order logic, to solve complex problems effectively.
CO3: Implement planning algorithms and demonstrate proficiency in reasoning under uncertainty using probabilistic reasoning and belief networks.
CO4: Utilize machine learning approaches such as inductive learning and neural networks to develop intelligent systems.
CO5: Analyze real-world case studies in AI applications across various domains to evaluate the effectiveness and relevance of AI techniques.

Catalog Description:

This course offers a comprehensive exploration of Artificial Intelligence (AI), covering topics such as intelligent agents, problem-solving, automated reasoning, planning, reasoning under uncertainty, and

machine learning. Students will delve into the principles of AI through lectures and hands-on exercises, gaining insights into state-of-the-art techniques and algorithms. Real-world case studies in AI applications across domains like robotics, speech/audio processing, IoT, and healthcare will be analyzed to illustrate the broad impact and potential of AI technologies.

Course Content

Unit I: **8 lecture hours**

Introduction to AI - Intelligent Agents, Problem-Solving Agents,
Automated Problem Solving- State Space, Problem Reduction, Game Playing, Constraint Satisfaction.

Unit II: **10 lecture hours**

Automated Reasoning - Proposition and first order logic, inference and deduction, resolution refutation, answer extraction, knowledge-based systems, logic programming, and constrained logic programming, non-monotonic reasoning.

Unit III: **9 lecture hours**

Planning: State-space, plan space and partial order planning, planning algorithms.

Unit IV: **8 lecture hours**

Reasoning under uncertainty: Probabilistic reasoning, belief networks.

Unit V: **10 lecture hours**

Learning: Inductive learning, decision trees, logical approaches, computational learning theory, neural networks, reinforcement learning, Intelligent agents, natural language understanding, and Applications.
Case studies on AI: Robotics and automation/ Speech and audio processing/ Signal processing and pattern recognition/Internet of Things (IoT) applications/ Wireless Communication and Networking/ Embedded Systems and Edge Computing/ Circuit Design and Optimization/ Energy Efficiency and Power Management/ Healthcare.

Text Books

1. Artificial Intelligence : A Modern Approach (Paperpack). Stuart Russell and Peter Norvig. Pearson; 3 edition. 2010 ISBN-13: 978-0132071482
2. Fundamentals of the New Artificial Intelligence. Toshinori Munakata. Springer Science & Business Media. ISBN 978-1-84628-839-5
3. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006. ISBN-13 978-0-387-31073-2.\
4. Artificial Intelligence (Third Edition).Elaine Rich,Kevin Knight,Shivashankar B. Nair. Tata McGraw-Hill Education Pvt. Ltd.. 2008. ISBN 13: 9780070087705

5. Reinforcement Learning: An Introduction. Richard S. Sutton Andrew G. Barto . MIT Press, 2017. ISBN-13: 9780262332767

Reference Books

1. Genetic Algorithms in Search, Optimization, and Machine Learning. David E. Goldberg. Pearson Education, 2006. ISBN-13: 9788177588293.
2. Principles Of Artificial Intelligence. N.J. Nilsson. Narosa Book Distributors. 2002.ISBN-13: 978-8185198293
3. Probabilistic Programming & Bayesian Methods for Hackers. Addison-Wesley Data and Analytics. ISBN-13: 978-0133902839.
4. Introduction to Information Retrieval South Asian Edition. Christopher D. Manning, Hinrich Schütze, and Prabhakar Raghavan. Cambridge University Press. 2008. ISBN-13: 978-1107666399.
5. Teaching statistics a bag of tricks. Andrew Gelman and Deborah Nolan. Oxford University Press, 2002. ISBN-13: 9780198572244.
6. Advanced Methods for Knowledge Discovery from Complex Data. Sanghamitra Bandyopadhyay. Springer Science & Business Media, 2005. ISBN-13: 9781852339890.
7. Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. Aurélien Géron. O'Reilly Media; 1 edition (April 9, 2017). ISBN-13: 978-1491962299.
8. Deep Learning. Ian Goodfellow, Yoshua Bengio, Aaron Courville. The MIT Press, 2016. ISBN-13: 978-0262035613.
9. Bayesian Data Analysis. Andrew Gelman, John Carlin, Hal Stern, David Dunson, Aki Vehtari, and Donald Rubin. Third Edition. 2013. ISBN-13: 978-1439840955.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Develop** proficiency in understanding the principles of intelligent agents and problem-solving techniques in AI.	**PO1, PO2, PO5**
CO2	**Apply** automated reasoning methods, including propositional and first-order logic, to solve complex problems effectively.	**PO1, PO2 PO4, PO5**
CO3	**Implement** planning algorithms and demonstrate proficiency in reasoning under uncertainty using probabilistic reasoning and belief networks.	**PO1, PO2, PO4, PO5, PO6**
CO4	**Utilize** machine learning approaches such as inductive learning and neural networks to develop intelligent systems.	**PO1, PO2, PO4, PO5, PO7**
CO5	**Analyze** real-world case studies in AI applications across various domains to evaluate the effectiveness and relevance of AI techniques.	**PO1, PO2, PO4, PO5, PO9, PO10**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
ECE11029	Intro-duction to Artificial Intell-igence	3	3		3	3	2	2		2	2			3	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

BME11031	Prof. Elective- IV (Telemedicine)	L	T	P	C
Version 1.0	Contact Hours - 40	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To familiarize students with basic concepts of Biotelemetry & Telemedicine
2. To teach students the application of Biotelemetry & Telemedicine

Course Outcomes

After completion of the course the students will be able to

CO1. Describe basic Telemetry, Biotelemetry & Telemedicine system and subsystems
CO2. Explain the application of Biotelemetry & Telemedicine in modern healthcare technology
CO3. Identify and describe modern telemedical technologies.

Course Description

Course Content

Module 1: Introduction to Medical Informatics:

Introduction to medical informatics, historical review of development of computers and informatics, structure of medical informatics, Application and importance of Medical informatics**,** Natural language processing, Knowledge and Models**,** Information and Communication Systems**,** Medical Computer Systems **-** Systematization of Computer Applications.

[09L]

Module 2: Management of Medical data:

Classification of medical data and information**,** uncertainty of medical data, examples of classification systems. Database management, development of database management system for a hospital environment

[06L]

Module 3: Security Issues:

Security Issues in Computer and Internet: Different types of security hazards and methods forprevention of

these hazards. Information Safety and Security in Health Care Information Systems

[06L]

Module 4: Applications of Computers in Medical Field:

Computers in Clinical Laboratory: Role and Applications of different equipment's employing computer in medical laboratory. Computers for Critically ill/handicapped: Role and Applications of different devices for handicaps and severely ill patients.

Health Care Information Systems: Introduction**,** Electronic Patient Record**,** Electronic referral - consulting system**,** Primary Care Systems**,** Clinical Departmental Information Systems**,** Clinical Support Systems**,** Nursing Information Systems.

Evaluation of health information systems and Technology. Introduction to Bio-informatics and computational biology

[09L]

Module 5: Introduction to Telemedicine:

Role of Telemedicine in healthcare, current applications of Telemedicine, medical peripheral devices, clinical education, hand held computers (PDA), Computer assisted surgery - Robotics, and computer assisted drug delivery.

[06L]

Module 6: Computers & Artificial Intelligence:

Medical decision-support systems, Medical Expert System. Rationales for computer- aided decision making**,** Decision models - quantitative models**,** qualitative models**,** Knowledge Based systems - characteristic features of KBS**,** knowledge representation in KBS**,** Artificial intelligence methods

[09L]

Text Books:	
1	Computers in Medicine: Progress in medical informatics – R.D.Lele, Tata McGraw Hill 2005.
2	J**.** H**.** van Bemmel and M**.** A**.** Musen (eds**.),** Handbook of Medical Informatics**.** Bohn Stafleu Van Loghum**,** Houten1997.
3	Enrico Coiera**:** Guide to Medical Informatics**,** the Internet and Telemedicine**.** Chapman & Hall Medical**,** London1997**.**
Reference Books:	
1	Bronzino JD**,** The Biomedical Engineering Handbook**,** IEEE Press**,**2000

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**

Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Describe** basic Telemetry, Biotelemetry & Telemedicine system and subsystems	**PO1, PO2, PO8, PO12, PSO3**
CO2	**Explain** the application of Biotelemetry & Telemedicine in modern healthcare technology	**PO1, PO3, PO8, PO11, PSO3**
CO3	**Identify** and describe modern telemedical technologies.	**PO1, PO2, PO8, PO12, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11031	Prof. Elective-IV (Telemedicine)	3	3	3					3			3	3			3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11024	Prof. Elective- IV (Rehabcare Engineering)	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	Not required				
Co-requisites	--				

Course Objectives

1. Apply measurement concepts and biomechanical principles to measure and analyze human movement in order to calculate forces, accelerations, etc., acting on or associated with specific joints or limbs.
2. Analyze stress/strain experienced by body parts and prosthetic elements, and evaluate related safety factors.
3. Work as part of a team to complete a multi-week research project and share the results of their research through an oral presentation.
4. Identify and discuss key elements and issues of rehabilitative/assistive technologies.

Course Outcomes

CO1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

CO2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as a global, cultural, social, environmental, and economic factor.

CO3. an ability to communicate effectively with a range of audiences

CO4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

CO5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Course Description

Introduction to technologies used for rehabilitation and improved function, including limb and spinal orthoses and prostheses, gait analysis, sensory aids, and augmentation

Course Content

Unit 1: Prosthetic and Orthotic Devices: Causes of Amputation, Types of Amputation, and levels of amputation for upper and lower Extremity. Hand and arm replacement, different types of models for externally powered limb prosthetics, lower limb, upper limb orthotics, spinal orthotics; Endo and Exo-skeletal Prosthetics; materials used for prosthetic and orthotic devices, mobility aids. Principles of three point pressure, total contact, partial weight bearing. Activities of Daily Living: ADL grouping, Barthel's Index of ADL.

Unit 2: Auditory And Speech Assist Devices: Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer.

Unit 3: Visual Aids: Causes of visual impairments; Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers.

Unit 4: Muscle impairments and Medical Stimulator: Muscular impairments: Muscular Dystrophy, Duchenne Muscular Dystrophy, Facioscapulohumeral Muscular Dystrophy, Paraplegia, Quadriplegia: Etiology, Mechanism of injury and management. Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices, Design issues.

Unit 5: Therapies for deformities and muscular impairments: Types of deformities; Management of 1st and 2nd degree deformities; Common deformities of lower limb, partial foot deformities, Deformities of the foot, Arm deformities, Torticollis.

Text Book(s):

1. Rory A Cooper; An Introduction to Rehabilitation Engineering; CRC press; 2006
2. Albert M.Cook and JG Webster; Therapeutic Medical devices; Prentice Hall Inc., NewJersy; 1982.

Reference Book(s):

1. Joseph D. Bronzino; The Biomedical Engineering Handbook; 3rd Edition; Three Volume Set; CRC Press; 2006.
2. Ed: S.N. Levine; Advances in Bio Medical Engineering and Medical Physics; Inter University Publication, New York; 1968.
3. J Reswick; What is Rehabilitation Engineering, Annual review of Rehabilitation; Volume: 2, Springer-Verlag, New York; 1982.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes

CO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	**PO3, PO4, PO5 PSO2, PSO3**
CO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as a global, cultural, social, environmental, and economic factor.	**PO3, PO4, PO5 PSO2, PSO3**
CO3	an ability to communicate effectively with a range of audiences	**PO3, PO4, PO5 PSO2, PSO3**
CO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	**PO3, PO4, PO5 PSO2, PSO3**
CO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11024	Prof. Elective- IV (Rehabcare Engineering)			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

ECE11032	**Advanced Machine Learning**	L	T	P	C
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Basic knowledge of Probability and Linear Algebra				
Co-requisites	Introduction to Machine Learning				

Course Objectives

1. Introduce students to the history and foundational concepts of Deep Learning, including McCulloch Pitts Neuron and Multilayer Perceptrons (MLPs).
2. Explain various activation functions and optimization techniques used in Deep Learning, such as Gradient Descent and Principal Component Analysis.
3. Explore the principles of autoencoders and regularization methods in Deep Learning, including their applications in denoising and sparse autoencoders.
4. Discuss advanced Deep Learning models like Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), along with their architectures and applications.
5. Examine real-world applications of Deep Learning in image processing, natural language processing, speech recognition, and video analytics.

Course Outcomes

On completion of this course, the students will be able to

CO1: Gain proficiency in understanding the historical background and fundamental concepts of Deep Learning, including McCulloch Pitts Neuron and Multilayer Perceptrons (MLPs).
CO2: Apply various activation functions and optimization techniques, such as Gradient Descent and Principal Component Analysis, to train Deep Learning models effectively.
CO3: Implement autoencoders and regularization methods in Deep Learning, including denoising and sparse autoencoders, to improve model performance.
CO4: Analyze and evaluate advanced Deep Learning models like Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) in terms of architecture and applications.
CO5: Demonstrate the ability to apply Deep Learning techniques to real-world problems in image processing, natural language processing, speech recognition, and video analytics.

Catalog Description:

This course provides a comprehensive understanding of Deep Learning, covering topics such as neural network architectures, activation functions, optimization techniques, autoencoders, regularization methods, and advanced Deep Learning models. Students will learn about the history and development of Deep Learning, explore various techniques for model training and optimization, and analyze real-world applications in image processing, natural language processing, speech recognition, and video analytics. Through lectures and hands-on exercises, students will gain practical skills in designing and implementing Deep Learning models using modern tools and techniques.

Course Content

Unit I: **8 lecture hours**

Introduction:
History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Backpropagation

Unit II: **10 lecture hours**

Activation functions and parameters:
Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis and its interpretations, Singular Value Decomposition, Parameters v/s Hyper-parameters

Unit III: **9 lecture hours**

Auto-encoders & Regularization:
Auto encoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Encoder Decoder Models, Attention Mechanism, Attention over images, Batch Normalization

Unit IV: **8 lecture hours**

Deep Learning Models:
Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. Introduction to RNNs, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Unit V: **10 lecture hours**

Deep Learning Applications:
Image Processing, Natural Language Processing, Speech recognition, Video Analytics

Laboratory/ Practicals (if any):
1. Implementation of the following deep learning algorithms in Python using TensorFlow: Convolution Neural Network
2. Implementation of the following deep learning algorithms in Python using TensorFlow: Recurrent Neural Network
3. Project work involving the application of Deep Learning

Text Books

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT Press, 2016
2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and Trends in Machine Learning 2.1, Now Publishers, 2009
3. Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi 2020.
4. https://nptel.ac.in/courses/106/106/106106184/
5. https://www.coursera.org/specializations/deep-learning

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Gain proficiency in understanding** the historical background and fundamental concepts of Deep Learning, including McCulloch Pitts Neuron and Multilayer Perceptrons (MLPs).	**PO1, PO2, PO5**
CO2	**Apply** various activation functions and optimization techniques, such as Gradient Descent and Principal Component Analysis, to train Deep Learning models effectively.	**PO1, PO2 PO4, PO5, PO6**
CO3	**Implement** autoencoders and regularization methods in Deep Learning, including denoising and sparse autoencoders, to improve model performance.	**PO1, PO2, PO4, PO5, PO6**
CO4	**Analyze and evaluate** advanced Deep Learning models like Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) in terms of architecture and applications.	**PO1, PO2, PO4, PO5, PO6, PO9, PO10**
CO5	**Demonstrate** the ability to apply Deep Learning techniques to real-world problems in image processing, natural language processing, speech recognition, and video analytics.	**PO1, PO2, PO6, PO7, PO8, PO9, PO10**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
ECE11032	Advanced Machine Learning	3	3		3	3	3	3	3	3	3			3	3

1=weakly mapped

2= moderately mapped

3=strongly mapped

ECO11505	**HSSM –IV (Economics for Engineers)**	L	T	P	C
Version 1.0	**Contact Hours – 45**	3	0	0	3
Pre-requisites/Exposure	12^{th} level Mathematics				
Co-requisites					

Course Objectives

1. Prepare engineering students to function in the business and management side of professional engineering practice.
2. Help students in general to analyse, understand and explain the past, present economic conditions of the country.
3. To forecast the future course of changes and development through their knowledge of policies and programmes set by the governments and other development agencies.
4. Evaluate the economic theories, cost concepts and pricing policies.
5. Apply the concepts of financial management for project appraisal.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the basic economic concepts and make economic analyses in the decision making.

CO2. Apply principals of economics to analyze the behaviour of consumers and producers in a well-functioning economy and also in case of market failures.

CO3. Develop the ability to account for time value of money using factors and formulas, estimate annual and future worth comparisons for cash flows.

CO4. Understand how factor market works, identify the manpower and resources management, need of credit/finance for initiating and accelerating projects.

Course Description

This paper introduces students to the terminology and analytic principles used in microeconomics, which is broadly defined as the study of markets, and to the application of these conceptual tools to several policy issues. As the design and manufacturing process become more complex, an engineer is required to make decisions that involve money more than ever before. The competent and successful engineer at present must have an improved understanding of the principles of economics. This paper is concerned the analysis of individual behaviors and market structure, and systematic evaluation of the benefits and costs of projects involving engineering design and analysis.

Course Content

Module 1: Basic Concepts of Economics: **[10 lecture hours]**

Introduction to the Literature of Microeconomics centering around Decision Making at Individual Level. Some Fundamental Concepts: Maximization, Equilibrium and Efficiency.

Module 2: Theories of Economics: **[12 lecture hours]**

The Theory of Consumer Choice and Demand, the Theory of Supply, market equilibrium, market structure, market failure and environmental issues, Game Theory, concept of yield and Theories of Term Structure, the Theory of Asset Pricing, decision-making under uncertainty: risk and insurance.

Module 3: Sustainability Study of a Project: **[5 lecture hours]**

Budget plan, estimation of the project cost, prices, fees and cost recovery, financing of recurrent costs, sustainability of the activities generated by the project.

Module 4: Economic Feasibility Study: **[12 lecture hours]**

Problem of pricing under oligopoly, problem of market stagnation, problem of volatility in open economy, problem of global meltdown, problem of financing a project.

Module 5: Project Report: **[6 lecture hours]**

Facets of project viability – commercial, technical, financial, outline of a model project report, a real life case study.

Text Books:

1. R. Panneersalvam, *Engineering Economics*, 2nd Ed., Prentice Hall of India, 2014.
2. James Riggs, *Engineering Economics*, 4th Ed., McGraw Hill Education, 2004.

Reference Books:

1. Donald G. Newnan, Ted G. Eschenbach and Jerome P. Lavelle, *Engineering Economic Analysis*, 13th Ed., Oxford University Press, 2017.
2. Chan S. Park, *Contemporary Engineering Economics*, 6th Ed., Pearson, 2015.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Understand the basic economic concepts and make economic analyses in the decision making.	**PO3, PO4, PO5 PSO2, PSO3**
CO2	Apply principals of economics to analyze the behaviour of consumers and producers in a well-functioning economy and also in case of market failures.	**PO3, PO4, PO5 PSO2, PSO3**
CO3	Develop the ability to account for time value of money using factors and formulas, estimate annual and future worth comparisons for cash flows.	**PO3, PO4, PO5 PSO2, PSO3**
CO4	Understand how factor market works, identify the manpower and resources management, need of credit/finance for initiating and accelerating projects.	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
ECO11505	HSSM –IV (Economics for Engineers)			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12028	Prof. Core- XII Lab (Measurements and Control Systems)	L	T	P	C
Version 1.0	Contact Hours - 45	0	0	3	2
Pre-requisites/Exposure	Knowledge in Digital Electronics				
Co-requisites	--				

Course Objectives

The student should be made to

1. To provide an in-depth knowledge of the core principles, their experimental basis of measurement systems.
2. To enable students to acquire a concept and understanding of the theoretical and technical basis for biophysical measurement and systems.
3. This course focuses on the phenomena related to the interaction and communication between living cells and their molecular constituents.
4. This course drawing on advanced methods used within the fields of molecular, cellular andclinical biochemistry and biophysics.

Course Outcomes

CO1. Develop an awareness of ethical responsibilities when conducting and reporting research in the biological control system and biological regulatory processes.

CO2. An ability to understand environmental considerations and sustainable engineering solutions in Biological Control System.

CO3. Develop an ability to understand professional ethics and legal issues related to Biological Control System and Healthcare Technologies.

CO4. Develop an ability to function effectively as an individual and a member in diverse team.

CO5. Develop an ability to communicate effectively with a range of audiences.

CO6. Develop an ability to understand management principles and apply these to manage projects and finance.

CO7. Develop an ability to engage in continuing professional development for lifelong learning.

Course Description

For engineering courses, Mathematics is the backbone. Students will have good engineering skills if their idea for Mathematics is clear. In this course, the focus will be on learning Mathematics in depth, which will motivate students to grow their thinking ability for Engineering also. By knowing the theory, a student will be able to apply that successfully to all kinds of problems in Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to participate actively in all group activities (Problem-solving, presentation, etc.).

Course Content

Experiment List:

1. Familiarization with Control System Toolbox in MATLAB
2. Determination of overall transfer function from the block diagram of a system (by the concept ofSIGNAL FLOW GRAPH)
3. Finding steady state error of Type-0, Type-1 &Type-2 systemsfor step, ramp and parabolic inputs
4. Time domain analysis of 1st order system (e.g., RC and RL switching circuits)
5. Time response analysis of a 2nd order system and finding its time domain specifications
6. Finding Root locus, Nyquist and Bode plot of a given transfer function and analysing its stability fromthe plots
7. Study of a practical position control system
8. P, PI and PID tuning using Ziegler–Nichols method
9. Lead compensator design using SISOTOOL
10. Lag compensator design using SISOTOOL
11. Obtaining transfer function of a given system from state variable model and vice versa. State variableanalysis of a physical system and obtaining step response of that system
12. Studying the characteristics and determining the transfer function of a small a.c. servomotor
13. Mini Project

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Develop an awareness of ethical responsibilities when conducting and reporting research in the biological control system and biological regulatory processes.	**PO3, PO4, PO5 PSO2, PSO3**
CO2	An ability to understand environmental considerations and sustainable engineering solutions in Biological Control System.	**PO3, PO4, PO5 PSO2, PSO3**
CO3	Develop an ability to understand professional ethics and legal issues related to Biological Control System and Healthcare Technologies.	**PO3, PO4, PO5 PSO2, PSO3**
CO4	Develop an ability to function effectively as an individual and a member in diverse team.	**PO3, PO4, PO5 PSO2, PSO3**
CO5	Develop an ability to communicate effectively with a range of audiences.	**PO3, PO4, PO5 PSO2, PSO3**
CO6	Develop an ability to understand management principles and apply these to manage projects and finance.	**PO3, PO4, PO5 PSO2, PSO3**

CO7	Develop an ability to engage in continuing professional development for lifelong learning.	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12028	Measurements and Control Systems Lab			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME12029	Prof. Core- XIII Lab (Digital Image Processing Lab)	L	T	P	C
Version 1.0	Contact Hours - 45	0	0	3	2
Pre-requisites/Exposure	Knowledge in Digital Electronics				
Co-requisites	--				

Course Objectives

1. To practice and get used to the basic image processing techniques.
2. To be able to understand and compute magnitude and phasor representation of images.
3. To understand the concepts of image restoration and segmentation.
4. To explore the applications of image processing techniques with MATLAB / C/ Labview/ similar software.

Course Outcomes

CO6. Students will be able to perform enhancing operations on the image using spatial filters and frequency domain filters.
CO7. Able to perform segmentation operations in the images.
CO8. Use transforms and analyze characteristics of the image.
CO9. Capable of comparing different image processing techniques.
CO10. Able to apply image processing techniques to solve real health care problems.

Course Description

For engineering courses, Mathematics is the backbone. Students will have good engineering skills if their idea for Mathematics is clear. In this course, the focus will be on learning Mathematics in depth, which will motivate students to grow their thinking ability for Engineering also. By knowing the theory, a student will be able to apply that successfully to all kinds of problems in Engineering and science. Class participation is a fundamental aspect of this course. Students will be encouraged to participate actively in all group activities (Problem-solving, presentation, etc.).

Course Content

List of Experiments:

1. To study the Image Processing Concept
2. To obtain histogram equalization
3. To implement smoothing or averaging filter in spatial domain
4. Program for opening and closing the image.
5. To fill the region of interest for the image

6. Program for edge detection algorithm.
7. Program for sharpen image using gradient mask.
8. Program for morphological operation: erosion and dilation
9. Program for DCT/IDCT computation

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Students will be able to perform enhancing operations on the image using spatial filters and frequency domain filters.	**PO3, PO4, PO5 PSO2, PSO3**
CO2	Able to perform segmentation operations in the images.	**PO3, PO4, PO5 PSO2, PSO3**
CO3	Use transforms and analyze characteristics of the image.	**PO3, PO4, PO5 PSO2, PSO3**
CO4	Capable of comparing different image processing techniques.	**PO3, PO4, PO5 PSO2, PSO3**
CO5	Able to apply image processing techniques to solve real health care problems	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12029	Prof. Core-XIII Lab (Digital Image Processing Lab)			3	3	3									3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11033	Prof. Elective- V (Modelling and simulation of biomedical systems)	L	T	P	C
Version 1.0	**Contact Hours – 40**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To describe general methods and principles for modelling and simulating a system.
2. To apply these principles when designing mathematical models for realistic systems.
3. To implement and use computer-based modelling and simulation for studying relevant problems.
4. To apply these methods and principles for modelling of systems and processes relevant for diagnostics, treatment and as well as different physiological processes.
5. To assess the pertinency and usability for diverse models and simulation procedures.

Course Outcome

After completion of the course the students will be able to

CO1. Describe general methods and principles for modelling and simulating a system.
CO2. Apply these principles when designing mathematical models for realistic systems.
CO3. Implement and use equivalent circuit model for studying relevant problems within the field of biomedical engineering.
CO4. Apply these methods and principles for modelling of systems and processes relevant for diagnostics, treatment and as well as different physiological processes.
CO5. Critically evaluate the applicability and usability for different models and simulation techniques.

Course Description

The purpose of the course is to introduce and apply methods of general interest in modelling and simulations. The course aims at giving a mix between theory and hands on practice in relevant application areas. The focus is to study methods and applications that are of relevance in biomedical engineering within diagnostic and therapeutic applications as well as for physiological processes.

Course Content

Module 1: Approaches to modelling

The technique of mathematical modelling, classification of models, characteristics of models.Purpose of physiological modelling and signal analysis, linearization of nonlinear models. Time invariant and time varying systems for physiological modelling
[15L]

Module 2: Equivalent circuit model

Electromotive, resistive and capacitive properties of cell membrane change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of thewhole neuron. Huxley model of isotonic muscle contraction, modelling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis.

[15L]

Module 3: Physiological modelling

Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop, and Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria.

[15L]

Text Books:	
1	Endarle, Blanchard & Bronzino, Introduction to Biomedical Engg. , Academic press..
2	Suresh. R. Devasahayam, Signals & Systems in Biomedical Engineering, Kluwer Academic/ Plenum Publishers.
3	V.Z. Marmarelis, Advanced methods of physiological modeling, Plenum Press
Reference Books:	
1	J. Candy, Signal Processing: The Model Based approach, Mc. Graw Hill.
2	L.Stark, Neurological Control System, Plenum Press
3	R.B. Stein, Nerve and Muscle, Plenum Press.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Describe** general methods and principles for modelling and simulating a system	**PO1, PO2, PO8, PO12, PSO3**
CO2	**Apply** these principles when designing mathematical models for realistic systems**.**	**PO1, PO3, PO8, PO11, PSO3**
CO3	**Implement** and use equivalent circuit model for studying relevant problems within the field of biomedical engineering.	**PO1, PO2, PO8, PO12, PSO3**
CO4	**Apply** these methods and principles for modelling of systems and processes relevant for diagnostics, treatment and as well as different physiological processes	**PO1, PO3, PO8, PO11, PSO3**
CO5	**Critically evaluate** the applicability and usability for different models and	**PO1, PO3, PO8,**

	simulation techniques.	**PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11033	Prof. Elective-V (Modelling and simulation of biomedical systems)	3	3	3					3			3	3			3

1 = weakly mapped, 2 = moderately mapped, 3 = strongly mapped

ECE12038	**Introduction to Machine Learning Lab**	L	T	P	C
Version 1.0	**Contact Hours - 45**	0	0	2	2
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

1. Introduce students to Python programming fundamentals and their application in machine learning.
2. Familiarize students with essential Python libraries for mathematical computing and data manipulation.
3. Enable students to implement basic machine learning models using Python for data analysis and predictive modeling tasks.

Course Outcomes

On completion of this course, the students will be able to

CO1: Implement basic machine learning algorithms using Python.
CO2: Apply Python libraries for mathematical computation and data manipulation.
CO3: Develop proficiency in handling exceptions and accessing databases in Python.
CO4: Demonstrate understanding of fundamental programming concepts and their application in machine learning.

Catalog Description:

This course introduces Python programming tailored for machine learning applications, covering basics like loops, conditions, and functions. Students learn to handle exceptions, access databases, and utilize Python libraries such as NumPy, Matplotlib, Pandas, TensorFlow, and Keras for mathematical computing. Through practical exercises, they develop proficiency in implementing basic machine learning models like SVM, KNN, K-Means, Logistic Regression, and Linear Regression. By the end, students acquire essential Python programming skills and the ability to apply machine learning algorithms to real-world data analysis tasks effectively.

Course Content

1. Python Introduction

2. Loops and Conditions and other preliminary stuff,

3. Functions, Classes and Modules,

4. Exceptions, Database access,

5. Mathematical computing with Python packages like: numpy, Mat- plotLib, pandas Tensor Flow, Keras

6. Implement basic ML models like SVM, KNN, K-Means, Logistic Regression, Linear Regression

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes
CO1	**Implement** basic machine learning algorithms using Python.	PO1, PO5
CO2	**Apply** Python libraries for mathematical computation and data manipulation.	PO2, PO4
CO3	**Develop** proficiency in handling exceptions and accessing databases in Python.	PO3, PO6, PO8, PO9
CO4	**Demonstrate** understanding of fundamental programming concepts and their application in machine learning.	PO10, PO11, PO12

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	
ECE12038	Intro-duction to Machine Learning Lab	3	3	3	2	2	2			2	2			3	

1=weakly mapped

2= moderately mapped

3=strongly mapped

SEMESTER VII

MGT11402	HSSM –V (Industrial Management)	L	T	P	C
Version 1.0	**Contact Hours – 40**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To enable students to understand operational complexities of a business.
2. To enable students to conceptualize the process, functions and theories of management.
3. To enable students to provide knowledge about quality control processes.
4. To enable students to conceptualize different strategies relating to people management.

Course Outcome

On completion of this course, the students will be able to
CO1. Understand operational complexities of a business.
CO2. Explain the concept of process, functions and theories of management.
CO3. Explain the knowledge about quality control processes.
CO4. Explain the concept of different strategies relating to information System management
CO5. Explain the concept of different strategies relating to people management.

Course Description

The purpose of this course is to provide an understanding of the theories and principles of modern management and encourage the course participants to make an appreciation of these principles in relation to their own experiences and selected managerial case studies. The aims of the course are to understand the basic principles of management, and the four major functions of managers e.g., planning, organizing, leading and controlling and how managers actually operate. Students will be required to think critically and strategically about management theories and issues which will enable them to develop their decision-making and analytical skills. They will be involved in application exercises and case studies, which will assist them to develop graduate attributes.

Course Content

Module 1: Classification and Importance of Operations Management [10 Lecture Hours]
Operations Management in corporate profitability & competitiveness; Operations strategy; Types & characteristics of manufacturing systems & service systems.
Module 2: Operations Planning and Control [10 Lecture Hours]
Forecasting for operations; Inventory planning & control; Materials requirement planning; Planning production in aggregate terms; Operations scheduling;
Module 3: Quality Assurance [5 Lecture Hours]
The quality assurance system; choice of process and reliability; control of quality.
Module 4: Maintenance Function [5 Lecture Hours]
Preventive maintenance; Overhaul and replacement.
Module 5: Management Information System [10 Lecture Hours]
Need & structure of MIS; Data Processing Systems; Data Sources & Management.

Module 6: Human Resource Management **[5 Lecture Hours]**

Concept and evolution; Manpower planning; recruitment and selection; Motivating personnel; Leadership

Text Books:

1. Yadav, Shashi Kant, Textbook of Industrial Management. Discovery Publishing Pvt. Ltd. ISBN-10: 8183568424 ISBN-13: 978-8183568425.

2. Khanna, O. P., Industrial Engineering and Management, Dhanpat Rai Publications, ISBN-10: 818992835X; ISBN-13: 978-8189928353

Reference Books:

1) Modern Production / Operations Management by Buffa & Sarin, 8th Ed., John Wiley
2) Operations Management by Russell & Taylor (Wiley India Pvt. Ltd.
3) Management Information Systems by Larry Long (Prentice Hall)
4) Enterprise Resource Planning by A. Leon (TMH)
5) Human Resource Management by C. B. Gupta (Sultan Chand).

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand** operational complexities of a business	**PO1, PO2, PO8, PO12, PSO3**
CO2	**Explain** the concept of process, functions and theories of management	**PO1, PO3, PO8, PO11, PSO3**
CO3	**Explain** the knowledge about quality control processes.	**PO1, PO2, PO8, PO12, PSO3**
CO4	**Explain** the concept of different strategies relating to information System management	**PO2, PO3, PO8, PO11, PO12, PSO3**
CO5	**Explain** the concept of different strategies relating to people management.	**PO2, PO3, PO8, PO11, PO12, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
MGT11402	HSSM –V (Industrial Management)	3	3	3					3			3	3			3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME11026	Prof. Core- XIV (Biomedical Instrumentation-II)	L	T	P	C
Version 1.0	Contact Hours – 45	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To Illustrate origin of bio potentials and its propagations
2. To understand the different types of electrodes and its placement for various recordings
3. To design bio amplifier for various physiological recordings
4. To familiarize students with biomedical recorders.
5. To introduce students with patient monitoring system & its characteristics.

Course Outcomes

CO1. Describe and characterize the sources of biomedical signals and the needs of using biomedical instruments & their limitations.

CO2. Understand & describe pc based medical instrumentation & regulation of medical devices.

CO3. Describe and characterize medical instruments as per their specifications and static & dynamic characteristics and understand the data acquisition system.

CO4. Describe, analyze, characterize and design Bio-amplifiers.

CO5. Understand, describe, characterize and design various medical recording systems & their components.

CO6. Understand and describe patient monitoring systems and their necessity in the healthcare system.

Course Description

Biomedical Instrumentation focuses on the devices and mechanics used to measure, evaluate, and treat biological systems. It focuses on the use of multiple sensors to monitor the physiological characteristics of a human.

Course Content

Module1: Prosthetics

Module 2: Clinical laboratory instrumentation: Emerging trends in medical diagnostics and therapy,Clinical laboratory instrumentation, Blood cell counter and associated haematology system, Endoscopic diagnosis and foreign body removal, medical image rendering, blood gas analysers, Design of haemodialysis Machine, Design of Electro surgical Generator orCautery.

Module 3: Measurements in the Respiratory System: The physiology of the respiratory system, Tests and instrumentation for the mechanics of breathing, Gas exchange and distribution, Respiratory diagnosing equipment (Spirometer)

Module 4: Structures of Discrete-Time Systems:

Realization of discrete-time systems, FIR systems: Direct, Cascade, Frequency Sampling and Lattice structures. Structures for IIR systems: Direct, Signal Flow Graphs and Transposed, Cascade, Parallel, Lattice and Lattice-Ladder structures. State space system analysis and structures
[10L]

Module 5: FIR Filter Design

Symmetric and Anti-symmetric FIR filters, FIR Filter design by window method (Rectangular, Bartlett, Hamming, Hanning, Blackman and Kaiser window), FrequencySampling method, Optimum approximation of FIR filters, Design of FIR differentiators,Design of Hilbert transformers
[10L]

Module 6: IIR Filter Design

Design of Discrete-time IIR filters from Continuous-time Filters: Filter design by Impulse invariant and bilinear transformation method: Butterworth, Chebyshev and Elliptic approximation Filter, Frequency transformation.
[10L]

Module 7: Multi-Rate Digital Signal Processing

Introduction, Decimation, Interpolation, Sampling rate conversion by rational factor, Filter design and implementation for sampling rate conversion: Direct form FIR digital filter structure, Polyphase filter structure, Time varying digital filter structure, sampling rate conversion by an arbitrary factor

Text Books:

1 Control Systems by Smarjit Ghosh, Pearson, second Impression, 2013
2 Control System Engg, by I.J.Nagrath& M Gopal, New age international publication, 4th Edition,2011.

Reference Books:

1 Automatic Control Systems by Benjamin C. Kuo, Prentice-Hall, 7th Edition, 2009.
2 Modern Control Engg. by K. Ogata PHI publication, 5th Edition, 2010.
3 Automatic control system by HasanSaeed, sixth revised edition 2008, S.K. Kataria& Sons.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Describe and characterize the sources of biomedical signals and the needs of using biomedical instruments & their limitations.	**PO1, PO2, PO8, PO12, PSO3**
CO2	Understand & describe pc based medical instrumentation & regulation of medical devices.	**PO1, PO3, PO8, PO11, PSO3**
CO3	Describe and characterize medical instruments as per their specifications and static & dynamic characteristics and understand the data acquisition system.	**PO1, PO2, PO8, PO12, PSO3**
CO4	Describe, analyze, characterize and design Bio-amplifiers.	**PO2, PO3, PO8, PO11, PO12, PSO3**
CO5	Understand, describe, characterize and design various medical recording systems & their components.	**PO2, PO3, PO8, PO11, PO12, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME11026	Prof. Core-XIV (Biomedical Instrumentation-II)	3	3	3					3			3	3			3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME	Troubleshooting and Quality Control of Medical Devices - Lab	L	T	P	C
Version 1.0	Contact Hours - 45	3	0	0	3
Pre-requisites/Exposure	12th level Physics, Chemistry, and Mathematics				
Co-requisites	--				

Course Objective

1. To provide adequate technical information operating principles of medical instruments
2. To train students for mastery in fault detection in several medical devices
3. To teach students about corrective measures to take after fault detection

Course Outcomes

After completing the course, the student will be able to

CO1. Gain adequate technical information operating principles of medical instruments

CO2. Learn about mastery in fault detection in several medical devices

CO3. Gain knowledge to students to enable them to troubleshoot the various equipment used in hospitals.

CO4. Learn about corrective measures to take after fault detection

Course Description

Through this course students will be able to gain adequate technical information operating principles of medical instruments and fundamentals of troubleshooting procedures. They will learn about testing of passive components and semiconductor devices, fault diagnosis in analog and digital integrated circuits.

Course Content

Unit I

Fundamental Troubleshooting Procedures

Making of an Electronic Equipment, causes of Equipment Failure, Troubleshooting Process and Fault-finding Aids, Troubleshooting Techniques, Grounding Systems in Electronic Equipment, Temperature Sensitive Intermittent Problems, and Correction Action to repair the Equipment.

Unit II

Testing of Passive Components and Semiconductor Devices

Testing: Resistors, Capacitors and Inductors, causes of failure for electronic components, Special diodes, Bipolar Transistors, Field effect Transistors

Unit III

Fault Diagnosis in Analog and digital Integrated Circuits
Fault Diagnosis in Op-Amp Circuits, Digital Troubleshooting Methods, Digital IC Troubleshooters, Circuit board Troubleshooting.

Unit IV
Biomedical Equipment Troubleshooting -I
Trouble shooting of ECG Machine, EEG Machine, Defibrillator Electrosurgical unit, Anaesthesia machine, Autoclaves and sterilizers, Endoscope.

Unit V
Biomedical Equipment Troubleshooting -II
Troubleshooting of Incubators, Nebulizer, Oxygen Concentrators

Text Books:

1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair and Maintenance", Tata McGraw-Hill, Second Edition 2009.
2. Dan Tomal and Neal Widmer, "Electronic Troubleshooting", McGraw Hill, 3rd Edition 2004.

Reference Books:

1. Nicholas Cram and Selby Holder, "Basic Electronic Troubleshooting for Biomedical Technicians", TSTC Publishing, 2nd Edition 2010.
2. World Health Organisation, "Maintenance and Repair of Laboratory, Diagnostic imaging and Hospital Equipment", Geneva,1994.
3. Ian R, McClelland , "X-ray Equipment maintenance and repairs workbook for Radiographers and Radiological Technologists", World Health Organisation, Geneva, 2004.
4. Ministry of Health and Family Welfare, "Medical Equipment Maintenance Manual- A first line maintenance guide for end users", New Delhi, October 2010.
5. Joseph.J, Panichello, "X-Ray Repair : A Comprehensive Guide to the Installation and Servicing of Radiographic Equipment", Charles C Thomas Publisher Ltd, 2nd Edition 2005.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Gain adequate technical information operating principles of medical instruments	**PO6, PO11, PSO3**
CO2	Learn about mastery in fault detection in several medical devices	**PO6, PO11, PSO3**
CO3	Gain knowledge to students to enable them to troubleshoot the various equipment used in hospitals.	**PO6, PO8, PO11, PSO3**
CO4	Learn about corrective measures to take after fault detection	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3

BME12012	Prof. Core- VI Lab (Microprocessors and microcontrollers Lab)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME	**Computational fluid mechanics**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 45**	3	0	0	3
Pre-requisites/Exposure	Fluid Mechanics, Continuum Mechanics and Fluid Dynamics				
Co-requisites	--				

Course Objective

1. Design the wing, bluff, blunt and slender structures.
2. Design a subsonic and supersonic wind tunnel.
3. Know the thermal analysis of structural components.
4. Static & Dynamic analysis of beams.
5. Structural analysis of wing structure.

Course Outcomes

After completing the course, the student will be able to
CO1. Do the flow analyze over the different types of structures.
CO2. Conduct the thermal analysis of structural components.
CO3. Simulate the combustion and heat transfer process.
CO4. Understand and evaluate the plausibility of the results, and validate them
CO5. Derive the order of accuracy of numerical schemes, and understand why, and how, particular treatment is to be used for convection and time schemes.

Course Description

The course gives a thorough knowledge and understanding of the finite volume method for computational fluid dynamics (CFD). The governing equations of fluid flow are recalled, and written in a general convection-diffusion form that is useful for the understanding of how the equations are solved in a CFD code. The equations must be discretized and reorganized to linear equation systems, that can be solved using boundary conditions and source terms. We

start by discretizing steady-state diffusion equations (e.g., steady-state heat conduction), applying boundary conditions and source terms, and solving the equations using linear solvers. We then add the convection term and study how the discretization must be adapted to the behavior of convection. In fluid flow problems, several equations are coupled. We study the coupling between pressure and velocity, which requires a special treatment to give stable results. We learn how to discretize the time derivative in different ways for unsteady problems. We finally see how turbulence is modelled by turbulence models that fit nicely into the concept of the finite volume method

Course Content

Module 1

Introduction: CFD Applications. Need for Parallel Computers in CFD algorithms. Models of flows. Substantial derivative, Divergence of velocity. Continuity, Momentum, and Energy Equations-Derivation in various forms. Integral versus Differential form of equations. Comments on governing equations. Physical boundary conditions. Forms of equations especially suitable for CFD work. Shock capturing, and shock fitting.

Module 2

Mathematical Behavior of Partial Differential Equation: Classification of partial differential equations. Cramer Rule and Eigen value methods for classification. Hyperbolic, parabolic, and elliptic forms of equations. Impact of classification on physical and computational fluid dynamics. Case studies: steady inviscid supersonic flow, unsteady inviscid flow, steady boundary layer flow, and unsteady thermal conduction, steady subsonic inviscid flow.

Module 3

Grid Generation and Adaptive Grids:

Need for grid generation and Body-fitted coordinate system. Structured Grids-essential features. Structured Grid generation techniques- algebraic and numerical methods. Unstructured Grids-essential features. Unstructured Grid generation techniques- Delaunay-Voronoi diagram, advancing front method. Surface grid generation, multi-block grid generation, and meshless methods. Grid quality and adaptive grids. Structured grids adaptive methods and unstructured grids adaptive methods.

Module 4

Discretization & Transformation:

Discretization: Finite differences methods, and difference equations. Explicit and Implicit approaches. Unsteady Problem -Explicit versus Implicit Scheme. Errors and stability analysis. Time marching and space marching. Reflection boundary condition. Relaxation techniques. Alternating direction implicit method. Successive over relaxation/under

relaxation. Second order Lax-Wendroff method, mid-point Leap frog method, upwind scheme, numerical viscosity, and artificial viscosity.

Transformation:

Transformation of governing partial differential equations from physical domain to computational domain. Matrices and Jacobians of transformation. Example of transformation. Generic form of the Governing flow equations in Strong Conservative form in the Transformed Space.

Module 5

Finite Volume Technique and Some Applications:

Spatial discretisation- cell centered and cell vertex techniques (overlapping control volume, duel control volume). Temporal discretisation- Explicit time stepping, and implicit time stepping. Time step calculation. Upwind scheme and high-resolution scheme. Flux vector splitting, approximate factorisation. Artificial dissipation and flux limiters. Unsteady flows and heat conduction problems. Upwind biasing.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Do the flow analyze over the different types of structures.	**PO6, PO11, PSO3**
CO2	Conduct the thermal analysis of structural components.	**PO6, PO11, PSO3**
CO3	Simulate the combustion and heat transfer process.	**PO6, PO8, PO11, PSO3**
CO4	Understand and evaluate the plausibility of the results, and validate them	**PO6, PO8, PO11, PSO3**
CO5	Derive the order of accuracy of numerical schemes, and understand why, and how, particular treatment is to be used for convection and time schemes.	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12012	Prof. Core- VI Lab (Microprocessors and microcontrollers Lab)						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME	**Prof. Elective – V - AI in Healthcare**	**L**	**T**	**P**	**C**
Version 1.0	**Contact Hours - 45**	3	0	0	3

Pre-requisites/Exposure	Linear algebra, Discrete Mathematics, Probability, Statistics, Data Structure
Co-requisites	--

Course Objective

1. To identify problems healthcare providers face that machine learning can solve
2. To analyze how AI affects patient care safety, quality, and research
3. To relate AI to the science, practice, and business of medicine
4. To apply the building blocks of AI to help you innovate and understand emerging technologies

Course Outcomes

After completing the course, the student will be able to

CO1. Identify problems healthcare providers face that machine learning can solve
CO2. Analyze how AI affects patient care safety, quality, and research
CO3. Relate AI to the science, practice, and business of medicine
CO4. Apply the building blocks of AI to help you innovate and understand emerging technologies

Course Description

Through this course students will be able to play a critical role in enhancing clinical decision-making with machine learning to build the treatments of the future. They will learn to build, evaluate, and integrate predictive models that have the power to transform patient outcomes. The course will begin by classifying and segmenting 2D and 3D medical images to augment diagnosis and then move on to modeling patient outcomes with electronic health records to optimize clinical trial testing decisions. Finally, build an algorithm that uses data collected from wearable devices to estimate the wearer's pulse rate in the presence of motion.

Course Content

Unit I
Introduction to Healthcare

1.Overview of Health Care Systems and Key Challenges
2. Physicians, Physician Practices, and Physician Payment
3. Hospitals, Other Provider Organizations, and Related Payment Systems
4. Intermediaries, Health Insurance Plans, and Health Care Financing
5. Health Care Products and Prescription Drugs, and Quality Measurement and Improvement

Unit II

Introduction to Clinical Data

1. Asking and answering questions via clinical data mining
2. Data available from Healthcare systems
3. Representing time, and timing of events, for clinical data mining
4. Creating analysis ready datasets from patient timelines
5. Handling unstructured healthcare data: text, images, signals
6. Putting the pieces together: Electronic phenotyping

Unit III

Fundamentals of Machine Learning for Healthcare

1. Introduction to Human and Artificial Intelligence: terminologies, computational models of intelligence; conceptual frameworks from cognitive and educational psychology, neuroscience, information theory, and linguistics; philosophical foundations of AI
2. Review of relevant mathematical and statistical concepts: logarithmic loss, cross entropy optimizing cost functions; linear and logistic regression.
3. Forms of Learning: supervised, semi-supervised, unsupervised, active, and transfer learning
4. Supervised Learning: (a) Decision trees, non-parametric methods for learning, support vector machines, (b) Bio-inspired Learning (from perceptron to deep learning): neural basis of computing, classical neural networks, deep neural networks, deep belief networks, recurrent neural networks, and convolutional neural networks.
5. Unsupervised Learning: basic and advanced clustering techniques, dimensionality reduction (feature selection and feature extraction)
6. Knowledge Representation and Reasoning: Prepositional logic, first-order logic, ontological engineering, probabilistic reasoning
7. Time-series analysis: temporal models (probabilistic reasoning over time)
8. Emerging paradigms and concepts in artificial social and emotional intelligence

Unit IV:

Applications

1. Unique characteristics and challenges in medicine and healthcare; History and status quo of intelligent and expert systems in medicine.
2. Risk stratification, patient outcome prediction, disease progression modeling
3. Clinical decision-making and intelligent systems to support evidence-based medicine
4. Phenotype and clinical/bio-marker discovery, Relevance to personalized medicine
5. Analysis of tissue morphology and other medical imaging applications

Unit V

Evaluations of AI Applications in Healthcare

1. AI in Healthcare
2. Evaluations of AI in Healthcare
3. AI Deployment
4. Downstream Evaluations of AI in Healthcare: Bias and Fairness

5. The Regulatory Environment for AI in Healthcare
Best Ethical Practices for AI in Health Care

Text Books:

1. Stuart Russell and Peter Norvig. 2009. Artificial Intelligence: A Modern Approach (3rd ed.). Prentice Hall Press, Upper Saddle River, NJ, USA.
2. Toby Segaran. 2007. Programming Collective Intelligence (First ed.). O'Reilly.
3. Tony J. Cleophas and Aeilko H. Zwinderman. 2015. Machine Learning in Medicine - a Complete Overview. Springer.
4. Sunila Gollapudi, S. 2016. Practical Machine Learning. Packt Publishing Ltd.
5. Peter Harrington. 2012. Machine Learning in Action. Manning Publications Co., Greenwich, CT, USA.

Reference Books:

1. Selected seminal and contemporary readings from peer-reviewed literature such as Proceedings of Machine Learning in Healthcare, Artificial Intelligence in Medicine, IEEE Transactions on Biomedical and Health Informatics, and other relevant venues.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	**Mid Term**	**Class Assessment**	**End Term**
Weightage (%)	**20**	**30**	**50**

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Identify problems healthcare providers face that machine learning can solve	**PO6, PO11, PSO3**
CO2	Analyze how AI affects patient care safety, quality, and research	**PO6, PO11, PSO3**
CO3	Relate AI to the science, practice, and business of medicine	**PO6, PO8, PO11, PSO3**
CO4	Apply the building blocks of AI to help you innovate and understand emerging technologies	**PO6, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME12012	Prof. Elective – V - AI in Healthcare						3		3			3				3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

	Medical Robotics	L	T	P	C
Version 1.0		3	0	0	3
Pre-requisites/Exposure	Engineering Physics				
Co-requisites	--				

Course Objectives

1. Learn about the types of medical robots used for surgery
2. Understand the kinematics and dynamics of the robot
3. Gain knowledge of the different methods and tools to deploy robot for surgery.

Course Outcomes

After the successful completion of this course, the student will be able to:
CO1. Analyze kinematic parameters of different robots.
CO2. Analyze dynamic parameters of robots and methods to improve its performance including energy requirements.
CO3. Develop an open and closed loop control system for a manipulator.
CO4. Develop a robot as per the user requirements

Catalog Description

Robotics Based Industrial Automation is an important subject in engineering, which mainly focuses on industrial automation through Robotics. It includes kinematics, dynamics and control of an industrial robot.

Course Content

Unit I: 9 lecture hours

Introduction:

Robotics trends and the future. Introduction: serial robot, parallel robot, exoskeleton, rehabilitation robot, mobile robot, flexible & space robot. Robot anatomy: links, joints and joint notation scheme, Degrees of Freedom (DOF), required DOF in a manipulator, arm configuration, wrist configuration; end-effector, human arm characteristics, design & control issues, manipulation & Control, robotics sensors, robot specification, different robot programming platform.

Unit I: 9 lecture hours

Robot Motion Analysis:

Introduction to co-ordinate frames mapping, mapping between rotated frames, mapping between translated frames, description of objects in space, the transformation of vectors - rotation & translation of vectors, composite transformations, inverting a homogeneous transform, fundamental rotation matrices – principle axes rotation fixed, Euler and equivalent angle axis representations.

Unit III: 10 lecture hours

Kinematics Manipulators:

The kinematic modelling of manipulator, direct kinematics, Denavit – Hartenberg notation, kinematic relationship between links, manipulator transformation matrix, the inverse kinematics manipulator: workspace, solvability of inverse kinematic model, singularities of manipulators.

Unit IV: 12 lecture hours

Differential Motion, Statics:

Linear and angular velocity of a rigid body, the relationship between the transformation matrix and angular velocity, mapping velocity vectors, velocity propagation along with links. manipulator Jacobian, Jacobian inverse, Jacobian singularities, static analysis. Jacobian in statics. Introduction to Dynamics: Lagrangian mechanics, Lagrange – Euler formulation, velocity of a point on the manipulator, the inertia tensor, the kinetic energy, the potential energy. equations of motions, the Lagrangian-Euler (LE) dynamic model algorithm.

Unit V: 9 lecture hours

Automation and Application of Robots:

Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. Modeling Automated Manufacturing Systems: Role of Performance Modeling, Performance Measures, Performance Modeling Tools: Simulation Models, Analytical Models.
Selection of Robot: Factors influencing the choice of a robot, robot performance testing, economics of robotization, Impact of robot on industry and society.

Text Books

1. Saha, Subir Kumar. Introduction to robotics. Tata McGraw-Hill Education, 2014.
2. Mittal, R. K., and I. J. Nagrath. Robotics and control. Tata McGraw-Hill, 2003.
3. Fu, King Sun, Ralph Gonzalez, and CS George Lee. Robotics: Control Sensing. Vis. Tata McGraw-Hill Education, 1987.

Reference Books

1. Craig, John J. Introduction to robotics: mechanics and control, 3/E. Pearson Education India, 2009.
2. Waldron, Kenneth J., Gary L. Kinzel, and Sunil K. Agrawal. Kinematics, dynamics, and design of machinery. John Wiley & Sons, 2016.
3. Groover, Mikell P., Mitchell Weiss, and Roger N. Nagel. Industrial robotics: technology, programming and application. McGraw-Hill Higher Education, 1986.
4. Schilling, Robert J. Fundamentals of robotics: analysis and control. Vol. 629. New Jersey: Prentice Hall, 1990.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination
Examination Scheme:

Components	Attendance	MTE	Class Assessment	ETE
Weightage (%)	10	20	20	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	Mapped Program Outcomes

CO1	Analyze kinematic parameters of different robots.	**PO1**
CO2	Analyze dynamic parameters of robots and method to improve its performance including energy requirements.	**PO1**
CO3	Develop open and close loop control system for a manipulator.	**PO1**
CO4	Develop a robot as per the user requirements	**PO1,PO3,PO5**
C05	Analyze and deploy Robots in given industrial requirements.	**PO1,PO3,PO5,PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	Medical Robotics	3		2		2								1	

1=weakly mapped
2= moderately mapped
3=strongly mapped

BME11034	Prof. Elective- V (Tissue Engineering)	L	T	P	C
Version 1.0	**Contact Hours – 40**	3	0	0	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To describe the principles of tissue engineering clinical applications of tissue engineered products in regenerative medicine
2. To establish the ability to predict single component fluid properties and changes in thermodynamic variables associated with intercellular processes associated with tissues
3. To define the importance of scaffold materials in tissue engineering with focus on surface-, mechanical- and biological properties
4. To describe Biotechnology of stem cells & its applications.

Course Outcome

After completion of this course the students will be able to

CO1. Demonstrate knowledge of the difference between cells and tissues and understand how complex structures can arise from simpler components.

CO2. Demonstrate the ability to predict single component fluid properties and changes in thermodynamic variables associated with intercellular processes associated with tissues.

CO3. Demonstrate understanding of common tissue engineering strategies and known solutions for organ replication.

CO4. Apply the combined knowledge of tissue organization and common tissue engineering strategies to design a unique, plausible tissue engineering solution.

Course Description

This course will provide an overview of cell biology fundamentals, an extensive review on extracellular matrix and basics of receptors, followed by topics on cell-cell and cell-matrix interactions at both the theoretical and experimental levels. Subsequent lectures will cover the effects of physical (shear, stress, strain), chemical (cytokines, growth factors), and electrical stimuli on cell function, emphasizing topics on gene regulation and signal transduction processes. Tissue engineering will be introduced by reviewing tissue structure and function and the clinical need for tissue repair. An overview of scaffold design and processing for tissue engineering will be reviewed and the application of tissue engineering to specialized tissues and organs will then be addressed in depth. Specific organ systems include skin, muscular skeletal system (vascular grafts, blood substitutions, cardiac patch, and heart valve), nervous system (peripheral and central nervous systems), liver, pancreas, and kidney

Course Content

Module 1:

Introduction, structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing. Cell culture- Different cell types, progenitor cells and cell

differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors. [12L]

Module 2:

Molecular biology aspect- Cell signalling molecules, growth factors, hormone and growth factor signalling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers. [08L]

Module 3:

Introduction to biomaterials and scaffolds, Criteria of modifying biomaterials as tissue engineering scaffolds, Properties and types of scaffolds, Different methods employed in the synthesis of scaffolds,animal cell biology, stem cells, organization of cells into tissues, tissue microenvironment, tissue injuryand wound healing 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. [15L]

Module 4:

Basic immunology, response of body to foreign materials. Animal cell culture on scaffolds, consequences, optimization strategies and important considerations for Skin, Liver, Bone, Cartilage,

Nerve and Vascular tissue engineering; Case study and regulatory issues-cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues [5L]

Module 5:

Biotechnology of stem cells & applications - Stem cell therapy in neurodegenerative disorders, cardiovascular disorders, metabolic/diabetic/systemic disorders, hematopoietic & autoimmune diseases, organ disorders, reproductive failures. [5L]

Text Books:	
1	Bernhard Palsson, Sangeeta Bhatia ,Tissue Engineering, Pearson Prentice Hall, 2003
2	Robert. P.Lanza, Robert Langer & William L. Chick, Principles of tissue engineering, Academicpress,1997
3	Gordana Vunjak-Novakovic, R. Ian Freshney, Culture of Cells for Tissue Engineering, WIS, 2006
Reference Books:	
1	B. Palsson, J.A. Hubbell, R.Plonsey& J.D. Bronzino, Tissue Engineering, CRC- Taylor &Francis
2	Joseph D., Bronzino The Biomedical Engineering –Handbook, CRC; 3rd edition , 2006

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Demonstrate** knowledge of the difference between cells and tissues and understand how complex structures can arise from simpler components	**PO1, PO2, PO8, PO12, PSO3**
CO2	**Demonstrate** the ability to predict single component fluid properties and changes in thermodynamic variables associated with intercellular processes associated with tissues	**PO1, PO3, PO8, PO11, PSO3**
CO3	**Demonstrate** understanding of common tissue engineering strategies and known solutions for organ replication	**PO1, PO2, PO8, PO12, PSO3**
CO4	**Apply** the combined knowledge of tissue organization and common tissue engineering strategies to design a unique, plausible tissue engineering solution	**PO1, PO3, PO8, PO11, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME11034	Prof. Elective- V (Tissue Engineering)	3	3	3					3			3	3			3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

	Prof. Core- X Lab (Biomedical Instrumentation – I Lab)	L	T	P	C
Version 1.0	**Contact Hours –**	0	0	3	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives:

6. To understand and implement isolation techniques in designing biomedical instruments.
7. To design temperature and humidity sensing module and pressure measurement system
8. To measure and Analyze ECG and EEG waveforms in diagnostic point of views
9. To measure oxygen saturation and pulse rate.
10. To understand the evaluation of auditory function using different devices

Course Outcomes:

After completion of this course, students will be able to –

CO6. Understand and implement isolation techniques in designing biomedical instruments.
CO7. Design temperature and humidity sensing module and pressure measurement system
CO8. Measure and Analyze ECG and EEG waveforms in diagnostic point of views
CO9. Measure oxygen saturation and pulse rate.
CO10. Understand the evaluation of auditory function using pure-tone audiometer and spirometer

Course Description

It is a core course for all UG Biomedical Engineering students.

Course Content

Experiment List:

9. Designing of a temperature and humidity sensing module
10. Designing of pressure measurement system by using LVDT
11. Acquisition and analysis of ECG signal
12. Acquisition and analysis of EEG signal
13. Evaluation of auditory function using a pure-tone audiometer
14. Measurement of oxygen saturation and pulse rate using pulse oxymeter
15. BP measurement using sphygmomanometer and stethoscope

16. Evaluation of auditory function using spirometer

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Understand** and implement isolation techniques in designing biomedical instruments.	**PO3, PO4, PO5 PSO2, PSO3**
CO2	**Design** temperature and humidity sensing module and pressure measurement system	**PO3, PO4, PO5 PSO2, PSO3**
CO3	**Measure** and Analyze ECG and EEG waveforms in diagnostic point of views	**PO3, PO4, PO5 PSO2, PSO3**
CO4	**Measure** oxygen saturation and pulse rate.	**PO3, PO4, PO5 PSO2, PSO3**
CO5	**Understand** the evaluation of auditory function using pure-tone audiometer and spirometer	**PO3, PO4, PO5 PSO2, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical	Analyze the results and problems related to the	Apply and disseminate the knowledge in
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
BME 12021	Prof. Core- X Lab (Biomedical Instrumentation – I Lab)			3	3	3									3	3

1 = weakly mapped

2 = moderately mapped

3 = strongly mapped

ECE12038	**Introduction to Machine Learning Lab**	L	T	P	C
Version 1.0	**Contact Hours - 45**	0	0	2	2
Pre-requisites/Exposure	Basic knowledge in Probability and Linear Algebra				
Co-requisites	----				

Course Objectives

1. Introduce students to Python programming fundamentals and their application in machine learning.
2. Familiarize students with essential Python libraries for mathematical computing and data manipulation.
3. Enable students to implement basic machine learning models using Python for data analysis and predictive modeling tasks.

Course Outcomes

On completion of this course, the students will be able to

CO1: Implement basic machine learning algorithms using Python.
CO2: Apply Python libraries for mathematical computation and data manipulation.
CO3: Develop proficiency in handling exceptions and accessing databases in Python.
CO4: Demonstrate understanding of fundamental programming concepts and their application in machine learning.

Catalog Description:

This course introduces Python programming tailored for machine learning applications, covering basics like loops, conditions, and functions. Students learn to handle exceptions, access databases, and utilize Python libraries such as NumPy, Matplotlib, Pandas, TensorFlow, and Keras for mathematical computing. Through practical exercises, they develop proficiency in implementing basic machine learning models like SVM, KNN, K-Means, Logistic Regression, and Linear Regression. By the end, students acquire essential Python programming skills and the ability to apply machine learning algorithms to real-world data analysis tasks effectively.

Course Content

1. Python Introduction

2. Loops and Conditions and other preliminary stuff,

3. Functions, Classes and Modules,

4. Exceptions, Database access,

5. Mathematical computing with Python packages like: numpy, Mat- plotLib, pandas Tensor Flow, Keras

6. Implement basic ML models like SVM, KNN, K-Means, Logistic Regression, Linear Regression

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Class Assessment	End Term
Weightage (%)	50	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Implement** basic machine learning algorithms using Python.	**PO1, PO5**
CO2	**Apply** Python libraries for mathematical computation and data manipulation.	**PO2, PO4**
CO3	**Develop** proficiency in handling exceptions and accessing databases in Python.	**PO3, PO6, PO8, PO9**
CO4	**Demonstrate** understanding of fundamental programming concepts and their application in machine learning.	**PO10, PO11, PO12**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long Learning	An ability to apply analytical knowledge, and modern hardware and software tools to design and implement complex systems in the areas related to Electronics and Communication systems	An ability to develop their problem-solving skills and assess social, environmental issues with ethics and manage different projects in multidisciplinary areas.
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
ECE12038	Intro-duction to Machine Learning Lab	3	3	3	2	2	2			2	2			3	2

1=weakly mapped
2= moderately mapped
3=strongly mapped

BME14035	Summer Internship	L	T	P	C
Version 1.0	**Contact Hours –**	0	0	0	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To prepare graduates with a broad knowledge of electrical engineering technology practices applicable to many different industry types.
2. To prepare graduates with key knowledge and skills in applied design, analysis, manufacture, test, and assembly of electrical systems.
3. To prepare graduates to be productive contributors in professional practice, graduate school, or some other career path.
4. To prepare graduates who know how to act in a professional manner, can continue to learn, and are capable of adapting to a continuously changing work environment.
5. To prepare graduates who can communicate effectively and who can contribute as members of a team.

Course Outcomes

On completion of this course, the students will be able to
CO1. Explain the operation of the industrial facility in which the student worked.
CO2. Understand problem solving by analyzing modern tools and devices.
CO3. Apply existing engineering knowledge in similar or new situations.
CO4. Identify when new engineering knowledge is required.
CO5. Understand lifelong learning processes through critical reflection of internship experiences.

Course Description

Through Internship students realize the importance of Professionalism in the workplace; that is, career development of him and his colleagues, remaining competent, working well with others, etc. Students realize the benefits of continuous learning, both formally and informally, throughout his career. Also, realize the need of continuously adapting his career to a "changing" workplace, and of staying current and competent throughout his career.

Course Content

The course involves compulsory training in an industrial environment for a specified duration. The course offers to connect the theoretical aspects and the laboratory scale learning with the industrial practices. Performance of the students is evaluated based on his/her submission of a certificate from the training organization followed by a seminar/viva-voce and report submission.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	Explain the operation of the industrial facility in which the student worked.	**PO1, PO6, PO7, PSO1, PSO2**
CO2	Understand problem solving by analyzing modern tools and devices.	**PO1, PO5, PO8, PO12, PSO1**
CO3	Apply existing engineering knowledge in similar or new situations.	**PO2, PO6, PO9, PO10, PSO2**
CO4	Identify when new engineering knowledge is required.	**PO2, PO9, PO10, PO12, PSO2**
CO5	Understand lifelong learning processes through critical reflection of internship experiences	**PO8, PO9, PO10, PO12, PSO1**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME14035	Summer Internship	3				1	3	1	3	3	3		3	3	3	

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME14036	Minor Project	L	T	P	C
Version 1.0	**Contact Hours –**	0	0	6	3
Pre-requisites/Exposure					
Co-requisites	--				

Course Objective

1. To be able to apply some of the techniques/principles you have been taught.
2. To carry out budget and time planning for the project.
3. To do effective trouble-shooting of the minor project.
4. To develop effective communication skill by delivering a seminar based on mini project.

Course Outcome

On completion of this course, the students will be able to
CO1. Investigate a real-world problem.
CO2. Utilize the modern tools to solve the problems.
CO3. Create a culture to work in a group to promote team spirit and leadership quality among the students.
CO4. Understand importance of projects involving both technological aspects and finance.
CO5. Identify newer areas of in-depth study and research and lifelong learning.

Course Description

The purpose of this course is to provide an active learning format in which students can develop the ability to read critically and conceptually, and therefore to speak and write with discrimination. Thus, develop skills in doing literature survey, technical presentation and report preparation.

Course Content

The Evaluation of the project work are to be carried out in the following way:
1. In-depth study of a topic proposed by the supervisor
2. Continuous Evaluation through guide.
3. An open pre-submission seminar by the student.
4. End-semester University Examination (An open seminar followed by a Viva voce)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Attendance	Class Assessment	End Term
Weightage (%)	20	10	30	40

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs

	Course Outcomes (COs)	Mapped Program Outcomes
CO1	I**nvestigate** a real-world problem.	**PO4, PO9, PO10, PO12, PSO2**
CO2	**Utilize** the modern tools to solve the problems	**PO4, PO5, PO8, PO10, PO12, PSO1**
CO3	**Create** a culture to work in a group to promote team spirit and leadership quality among the students	**PO2, PO8, PO9, PO10, PO12, PSO2**
CO4	**Understand** importance of projects involving both technological aspects and finance.	**PO8, PO9, PO10, PO11, PSO3**
CO5	**Identify** newer areas of in-depth study and research and lifelong learning	**PO8, PO9, PO10, PO12, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME14036	Minor Project		1		3	1			3	3	3	3	3	1	3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

SEMESTER VIII

BME14037	Major Project	L	T	P	C
Version 1.0	**Contact Hours –**	0	0	6	4
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. To be able to apply some of the techniques/principles you have been taught.
2. To carry out budget and time planning for the project.
3. To do effective trouble-shooting of the minor project.
4. To develop effective communication skill by delivering a seminar based on mini project.

Course Outcomes

On completion of this course, the students will be able to
CO1. Investigate a real-world problem.
CO2. Utilize the modern tools to solve the problems.
CO3. Create a culture to work in a group to promote team spirit and leadership quality among the students.
CO4. Understand importance of projects involving both technological aspects and finance.
CO5. Identify newer areas of in-depth study and research and lifelong learning.

Course Description

The seminar should provide an active learning format in which students can develop the ability to read critically and conceptually, and therefore to speak and write with discrimination. Thus, develop skills in doing literature survey, technical presentation and report preparation.

Course Content

The Evaluation of the project work are to be carried out in the following way:
1. In-depth study of a topic proposed by the supervisor
2. Continuous Evaluation through guide.
3. An open pre-submission seminar by the student.
4. End-semester University Examination (An open seminar followed by a Viva voce)

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Investigate** a real-world problem.	**PO4, PO9, PO10, PO12, PSO2**
CO2	**Utilize** the modern tools to solve the problems.	**PO4, PO5, PO8, PO10, PO12, PSO1**
CO3	**Create** a culture to work in a group to promote team spirit and leadership quality among the students.	**PO2, PO8, PO9, PO10, PO12, PSO2**
CO4	**Understand** importance of projects involving both technological aspects and finance.	**PO8, PO9, PO10, PO11, PSO3**
CO5	**Identify** newer areas of in-depth study and research and lifelong learning.	**PO8, PO9, PO10, PO12, PSO3**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BME14037	Major Project		1		3	1			3	3	3	3	3	1	3	3

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped

BME14038	Comprehensive Viva Voice	L	T	P	C
Version 1.0	**Contact Hours –**	0	0	0	2
Pre-requisites/Exposure					
Co-requisites	--				

Course Objectives

1. The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering acquired over 4 years of study in the undergraduate program.

Course Outcomes

On completion of this course, the students will be able to
CO1. Recall, recognize, visualize, illustrate, demonstrate, criticize and appraise the aspects of electrical engineering and the interaction among them.

Course Description

The viva shall normally cover the subjects taught in all the semesters of B.Tech Program.

Course Content

Every student will be required to undergo comprehensive vivavoce at the end of 8th semester of B.Tech Programme. The duration of the viva will range from 15-30 min. The examination committee will be constituted by the HoD and consist of at least three faculty.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Components	Mid Term	Class Assessment	End Term
Weightage (%)	20	30	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	Course Outcomes (COs)	**Mapped Program Outcomes**
CO1	**Recall,** recognize, visualize, illustrate, demonstrate, criticize and appraise the aspects of electrical engineering and the interaction among them.	**PO1, PO2, PO4, PO6, PO10, PO12, PSO1, PSO2**

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Understand the basic concepts of all the sub-domains of Biomedical Engineering.	Analyze the results and problems related to the health care sectors	Apply and disseminate the knowledge in designing and development of biomedical instruments and health care solutions
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BME14038	Comprehensive Viva Voice	3	3		3		3				3		3	3	3	

1 = weakly mapped
2 = moderately mapped
3 = strongly mapped