FACULTY OF ENGINEERING
DEGREE OF BACHELOR OF ENGINEERING IN BIOMEDICAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI

(2019-2020)

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Established Under Section 3 of UGC Act 1956)
COIMBATORE 641 021
INDIA.

B.E Biomedical Engineering **2019-2020**

Semester-I

19BEBME101 **Mathematics –I** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for the students

- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives and integrals.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To develop the knowledge in integral calculus.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To understand algebraic manipulation.

Course Outcomes

Upon completion of this course the students will be able

- To understand of the ideas of limits and continuity and ability to calculate with them and apply them.
- To apply various techniques in solving Partial Differential Equations
- To Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition change of order and vector integration.
- To understand the ideas of differential equations and facility in solving simple standard examples.
- To improve facilities in algebraic manipulation.

UNIT I - DIFFERENTIAL CALCULUS

Representation of functions, New functions from old functions, Limit of a function, Limits at infinity, Continuity , Derivatives, Differentiation rules, Polar coordinate system , Differentiation in polar coordinates, Maxima and Minima of functions of one variable.

UNIT II - FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives, Homogeneous functions and Euler's theorem, Total derivative, Differentiation of implicit functions, Change of variables, Jacobians, Partial differentiation of

implicit functions, Taylor's series for functions of two variables, Errors and approximations, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

UNIT III - INTEGRAL CALCULUS

Definite and Indefinite integrals, Substitution rule, Techniques of Integration, Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions, Improper integrals.

UNIT IV - MULTIPLE INTEGRALS

Double integrals, Change of order of integration, Double integrals in polar coordinates, Area enclosed by plane curves, Triple integrals , Volume of solids, Change of variables in double and triple integrals.

UNIT V - DIFFERENTIAL EQUATIONS

Method of variation of parameters, Method of undetermined coefficients, Homogenous equation of Euler's and Legendre's type, System of simultaneous linear differential equations with constant coefficients.

SUGGESTED READINGS

1. Erwin kreyszig, (2014), Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons,
2. B.S. Grewal, (2014) Higher Engineering Mathematics, 43rd Edition, Khanna Publishers,.
3. Bali N., Goyal M. and Watkins C, (2009), Advanced Engineering Mathematics, 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd),.
4. Hemamalini. P.T, (2014)&(2017),Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
5. James Stewart, (2008) Calculus with Early Transcendental Functions, Cengage Learning,
6. Narayanan S. and Manica vachagom Pillai T. K., (2007), Calculus Volume I and II, S. Viswanathan Publishers Pvt. Ltd,
7. Ramana B.V, (2010) Higher Engineering Mathematics, 11th Reprint,Tata McGraw Hill New Delhi,.
8. Jain R.K. and Iyengar S.R.K, (2007), Advanced Engineering Mathematics, 3rd Edition, Narosa Publications,.
9. Greenberg M.D., 5th Reprint, (2009)., Advanced Engineering Mathematics, 2nd Edition,5th Reprint, Pearson Education.
10. O'Neil, P.V, (2007), Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd,

B.E Biomedical Engineering **2019-2020**

Semester-I

19BEBME141 **Chemistry – I** **7H-6C**

(Theory & Lab.)

Instruction Hours/week: L:3 T:1 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Concepts in chemistry for engineering

Course Objective

- To understand the terminologies of atomic and molecular structure
- To study the basics of Periodic properties, Intermolecular forces
- To study about spectroscopic technique
- To understand the thermodynamic functions
- To understand the concept of chemical reactions
- To comprehend the basic organic chemistry and to synthesis simple drug.

Course Outcomes

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise bulk properties and processes using thermodynamic considerations.
- List major chemical reactions that are used in the synthesis of molecules.
- Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I - Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Pi-molecular orbitals of butadiene and benzene and aromaticity. Introduction to Crystal field theory.

UNIT II - Periodic properties, Intermolecular forces and potential energy surfaces

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.

UNIT III - Spectroscopic techniques and applications

Spectroscopy (Principles and Instrumentation only).Electronic spectroscopy. Vibrational and rotational spectroscopy. Applications. Surface characterization techniques SEM and TEM. Fluorescence and its applications in medicine.

UNIT IV - Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Significance of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications, Acid base, oxidation, reduction and solubility equilibria. Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT V - Organic reactions and synthesis of a drug molecule

Introduction to organic reactions and its mechanism involving substitution, addition, elimination, oxidation, reduction, cyclization and ring opening. Synthesis of a commonly used drug molecule.

SUGGESTED READINGS

1. B. H. Mahan, (2010).University chemistry, Pearson Education,
2. M. J. Sienko and R. A. Plane, Chemistry: Principles and Applications.
3. C. N. Banwell, (1994) Fundamentals of Molecular Spectroscopy, McGraw-Hill,.
4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTEL Web-book)
5. P. W. Atkins, (2009).Physical Chemistry, Oxford University Press,
6. K. P. C. Volhardt and N. E. Schore, (2014).5th Edition, Organic Chemistry: Structure and Function, W.H. Freeman,
7. P C Jain & Monica Jain, (2015). Engineering Chemistry, Dhanpat Rai Publishing Company,

(ii) Chemistry Laboratory

Course Objectives

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.
- To estimate the amount of sodium carbonate and sodium hydrogen carbonate, hardness, chloride in water sample
- To make the student acquire practical skills in the determination of conductance of solutions, EMF etc
- To acquaint the students with the determination of rate constant of a reaction
- To determine acid value of oil
- To carried out different types of titrations for estimation of concerned in materials

Course Outcomes

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Determine the partition coefficient of a substance between two immiscible liquids.
- Acquaint the students with the determination of acid value of an oil
- Carrying out different types of titrations for estimation of concerned in materials using comparatively more qualities and quantities of materials involved for accurate results

Choice of 10 experiments from the following:

1. Determination of surface tension and viscosity
2. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixture using volumetric titration
3. Determination of Ca / Mg using complexometric titration
4. Thin layer chromatography
5. Determination of chloride content of water
6. Determination of the rate constant of a reaction
7. Conductometry - Determination of cell constant and conductance of solutions
8. pH Metry – Determination of Acid / Base
9. Potentiometry - determination of redox potentials and emfs
10. Saponification/acid value of an oil
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal

13. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

19BEBME142 **Basic Electrical Engineering** **6H-5C**

(Theory & Lab.)

Instruction Hours/week: L:3 T:1 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives

- To impart the basic knowledge about the Electric circuits.
- To understand the concept of Electrical Machines and Transformers.
- To understand the basic concepts of star and delta connections
- To understand the operation of AC and DC circuits
- To understand the working of Semiconductor devices and Digital Circuits.
- To impart the basic knowledge of Measuring Instruments and Electrical Installation.

Course Outcomes

At the end of this course, students will be able to

- Attributing the electric circuits with DC and AC excitation by applying various circuit laws.
- Attributing the electrical machines and transformer.
- To understand the working principle of electronic devices and circuits
- Evaluate the various digital circuits in real time applications.
- Analysis various semiconductor devices in real time applications.
- Reproduce the Measuring Instruments and Electrical Installation.

UNIT I - DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT II - AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III - Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT IV - Transformers And Power Converters

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. Overviews of DC-DC buck and boost converters, duty ratio control. Introduction to Single-phase and three-phase voltage source inverters.

UNIT V - Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, RCCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

SUGGESTED READINGS

1. D. P. Kothari and I. J. Nagrath, (2010). Basic Electrical Engineering, Tata McGraw Hill,
2. D. C. Kulshreshtha, (2009).Basic Electrical Engineering, McGraw Hill,
3. L. S. Bobrow, (2011).Fundamentals of Electrical Engineering, Oxford University Press,
4. E. Hughes, (2010).Electrical and Electronics Technology, Pearson,
5. V. D. Toro, 1989.Electrical Engineering Fundamentals, Prentice Hall India,

(ii) Laboratory

Course Objective

- To impart the basic knowledge about the DC and AC Electric circuits.
- To understand the working of DC Machines and Energy Meter.
- To impart the knowledge of Logical digital circuits and their differences.

Course Outcomes (Cos)

At the end of this course, students will be able

- To understand and analyze basic electric and magnetic circuits.
- To understand and analyze the working principles of DC Machines and Energy Meter.
- Reproduce the Measuring Instruments and Electrical Installation
- Perform speed control for DC motor
- Draw the equivalent circuit of single phase Transformer
- Measure energy by using single phase energy meter

List of Experiments

1. Experimental verification of electrical circuit problems using Ohms law and Kirchoff's law.
2. Measurement of electrical quantities – voltage, current, power & power factor in R load.
3. Speed control of DC shunt motor
4. Draw the equivalent circuit of single phase Transformer by conducting OC &SC Test.
5. Measurement of energy using single phase energy meter.

SUGGESTED READING

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989

B.E Biomedical Engineering **2019-2020**

Semester-I

19BEBME143 **Programming For Problem Solving** **7H-5C**

(Theory & Lab.)

Instruction Hours/week: L:3T:0 P:4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students :

- Identify and understand the working of key components of a computer program.
- Identify and understand the various kinds of keywords and different data types of C programming
- Understand, analyze and implement software development tools like algorithm,
- pseudo codes and programming structure
- Study, analyze and understand logical structure of a computer program, and Different construct to develop a program in "C" language
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

COURSE OUTCOMES:

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

- understand the basic terminology used in computer programming
- write, compile and debug programs in C language.
- use different data types in a computer program.
- design programs involving decision structures, loops and functions.
- understand the dynamics of memory by the use of pointers
- Understand the concept of function and operator
- Develop programming skill and to solve engineering related problems.

Unit I – Introduction to Programming

Introduction to component so fa computer system disks, memory, processor, where a program is stored and executed, operating system, compilers - Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flow chart / Pseudocode with examples. From algorithms to programs; source code, variables with data types variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit II –Arithmetic expressions, precedence, Conditional Branching and Loops

[Arithmetic expressions and precedence– Conditional Branching- Loops-Writing and evaluation of conditionals and consequent branching – Iteration and loops.

Unit III - Array and Basic Algorithm

Arrays-Arrays1-D,2-D,Character arrays and Strings, Searching, Basic Sorting Algorithms-Bubble Insertion and Selection sorting, Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

Unit IV - Function and Recursion

Functions including using built in libraries Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, **Recursion:** Recursion, a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function. Quick sort or Merge sort.

Unit V - Structure, Pointers and File Handling

[Structures, Defining structures and Array of Structures,

Pointers: Idea of pointers, Defining pointers, Use of Pointers in self – referential structures, notion of linked list(no implementation), File handling.

SUGGESTED READINGS

1. E. Balagurusamy, (2017) Computing Fundamentals and C Programming, TMH Education, 5thEdition,
2. E. Balaguruswamy, (2017). ProgramminginANSIC, TataMcGraw-Hill, 7th Edition,
3. ByronGottfried, Schaum's (2017) OutlineofProgrammingwithC, McGraw-Hill, 3rd Edition,
4. BrianW.KernighanandDennisM.Ritchie, (2015).TheCProgrammingLanguage, Prentice HallofIndia, 2nd Edition,

(ii) Laboratory

Course Objectives

The goal of this course is for students:

- To compile, test, and debug simple Python programs.
- To evaluate Python programs with conditionals and loops.
- To utilize functions for structuring Python programs.
- To outline compound data using Python lists, tuples, and dictionaries.
- To apply data from/to files in Python.
- To do input/output with files in Python.

COURSE OUTCOMES:

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

- Compile, test, and debug simple Python programs.
- Illustrate Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Utilize Python lists, tuples, dictionaries for representing compound data.
- Recall and write data from/to files in Python.

- Apply Python features in developing software applications

List of Experiments

Tutorial 1: Problem solving using computers:

Lab 1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5:1DArrays: searching, sorting:

Lab 5:1DArray manipulation

Tutorial 6:2D arrays and Strings, memory structure:

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8and 9: Numericalmethods problems

Tutorial 10: Recursion, structure of recursive calls:

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

Semester-II

19BEBME201 **Mathematics – II** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students :

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To enable the students to apply the knowledge of Mathematics in various Engineering fields by making them to identify the functions in engineering problems as analytic function and their study as a functions of a complex variables.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as fluid dynamics and flow of the electric current etc.
- To make the student understand the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.
- To understand the concept of Matrices , Vector calculus, Analytic functions, Complex integration and Laplace transforms in their respective fields

COURSE OUTCOMES:

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

- To apply the Eigen values and eigenvectors, diagonalization of a matrix, nature and they will also be able to use matrix algebra techniques for practical applications.
- To find grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities, to evaluate line, surface and volume integrals in simple coordinate systems and to use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.
- To find the Analytic functions using the Cauchy Riemann equations and they will learn mapping properties of elementary functions and mapping properties of some special transcendental functions. They will understand relations between conformal mappings and quadratic differentials and how geometric structures are changing under conformal mappings.
- To evaluate complex integrals using the Cauchy's integral formula and the Residue theorem and to appreciate how complex methods can be used to prove some important theoretical results.
- To apply Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.
- In applying the concept of Matrices , Vector calculus, Analytic functions, Complex integration and Laplace transforms in their respective fields.

UNIT I - MATRICES

Eigen values and Eigenvectors of a real matrix, Characteristic equation, Properties of eigenvalues and eigenvectors, Cayley-Hamilton theorem, Diagonalization of matrices , Reduction of a quadratic form to canonical form by orthogonal transformation, Nature of quadratic forms. Simple Problems using Scilab.

UNIT II -VECTOR CALCULUS

Gradient and directional derivative, Divergence and Curl, Irrotational and Solenoidal vector fields, Line integral over a plane curve, Surface integral, Area of a curved surface, Volume integral, Green's, Gauss divergence and Stoke's theorems, Verification and application in evaluating line, surface and volume integrals.

UNIT III - ANALYTIC FUNCTION

Analytic functions, Necessary and sufficient conditions for analyticity, Properties, Harmonic conjugates, Construction of analytic function, Conformal mapping, Mapping by Functions $w = z + c$, cz, $1/z$, z^2 , Bilinear transformation.

UNIT IV- COMPLEX INTEGRATION

Line integral, Cauchy's integral theorem, Cauchy's integral formula, Taylor's and Laurent's series, Singularities, Residues, Residue theorem, Application of residue theorem for evaluation of real integrals, Use of circular contour and semicircular contour with no pole on real axis.

UNIT V - LAPLACE TRANSFORMS

Existence conditions, Transforms of elementary functions, Transform of unit step function and unit impulse function, Basic properties, Shifting theorems, Transforms of derivatives and integrals, Initial and final value theorems, Inverse transforms, Convolution theorem , Transform of periodic functions, Application to solution of linear ordinary differential equations with constant coefficients.

SUGGESTED READINGS

1. Erwin kreyszig, (2014).Advanced Engineering Mathematics, 9thEdition,John Wiley & Sons,
2. B.S. Grewal, (2014). Higher Engineering Mathematics, 43rd Edition, Khanna Publishers
3. Ramana B.V, (2010).Higher Engineering Mathematics, Tata McGraw Hill,
4. Hemamalini. P.T, (2014)&(2017)Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi,
5. Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, (2007)
6. Jain R.K. and Iyengar S.R.K, (2007).Advanced Engineering Mathematics , 3rd Edition, Narosa Publications,
7. Bali N., Goyal M. and Watkins C, (2009).Advanced Engineering Mathematics, 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.
8. O'Neil, P.V, (2007).Advanced Engineering Mathematics, Cengage Learning India Pvt.,Ltd

.

B.E Biomedical Engineering **2019-2020**

Semester-II

19BEBME202 **English** **4H-3C**

Instruction Hours/week: L:2 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence.
- To enable students to improve their technical writing

Course Outcomes

Students undergoing this course will be able to

- Use English language for communication: verbal & non –verbal.
- Enrich comprehension and acquisition of speaking & writing ability.
- Gain confidence in using English language in real life situations.
- Improve word power: lexical, grammatical and communication competence.
- write business letters and other forms of technical writing.
- prepare for oral communication in formal contexts.

Unit I -Basic Writing Skills

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

Unit II - Vocabulary Building

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

Unit III - Grammar and Usage

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies – Clichés

Unit IV - Listening and Reading Skills

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise.

Unit V.-**Writing Practices**

Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations.

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per unit.

SUGGESTED READINGS

1. Sangeeta Sharma , Meenakshi Raman, (2015), Technical Communication: Principles And Practice, 2nd Edition, OUP, New Delhi..
2. Sanjay Kumar and PushpaLata (2011)., Communication Skills , Oxford University Press,
3. Liz Hamp - Lyons and Ben Heasly (2006)., Study Writing, Cambridge University Press,
4. F.T. Wood., (2007).Remedial English Grammar, Macmillan,
5. Michael Swan, (1995), Practical English Usage, OUP.,.

Semester-II

19BEBME203 **Introduction To Biomedical Engineering** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

- To provide students with a broad overview of the Biomedical Engineering field
- To have a basic knowledge on medical devices and equipment
- To provide an overview of common areas available to BME graduates
- To be aware of ethical conduct and professional accountability.
- To perceive the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.
- To learn the patient safety measures

Course Outcomes

1. Ability to understand the concepts of medical devices and equipments
2. The student will learn about professional and ethical responsibility
3. The student will learn about contemporary BME research
4. Utilize different medical devices applied in measurement of parameters related to cardiology, neurology
5. Identify the electrical hazards and Implement methods of patient safety
6. List out the ethical values and issues

UNIT I - Introduction

Historical Perspective-Evolution of modern healthcare system, Roles played by Biomedical engineers, recent advance in biomedical engineering, Professional status of biomedical engineering, Professional societies. Physiological origins of bio signals and Imaging-Physiological Modelling -Linear Homomorphic saccadic eye movement

UNITII - Bio Medical Devices

Basic medical instrumentation system-Bio-potential measurements – Bioanalytical sensors-Diagnostic devices- ECG,EEG, EHG, EOG, EMG, blood pressure measurement, Audiometry, Temperature and Respiration rate measurement, Blood cell counters, optical pulse oximetry, Biochemical measurement techniques using light- General constraints in design of medical instrumentation systems.

UNITIII - Bio Imaging Systems

Principle and working of X-rays, Nuclear Imaging Techniques: -Positron Emission Tomography, SPECT, Optical imaging, microscopy, Magnetic Resonance Imaging, Scanners, Photo acoustic imaging, Ultrasound, Thermal imaging systems.

UNIT IV - Therapeutic and Assistive Instruments

Cardiac Pacemakers, Cardiac Defibrillators, Artificial heart, Instruments for Surgery, Haemodialysis Machines-Artificial Kidney, Dialyzers, Ventilators-Humidifiers, Nebulizers and Aspirators, Anaesthesia Machine, Prosthetic devices

UNITV – Ethics for Biomedical Engineers

Morality and Ethics-A definition of terms, Human Experimentation, Ethical issues in feasibility studies, Ethical issues in emergency use, Ethical issues in treatment use, Codes of ethics for bio engineers.

UGGESTED READINGS

1. Enderle,John, D., Bronzino, JosephD.,,Blanchard, SusanM, (2012).Introductionto Biomedical, Engineering, ElsevierInc, 3rd edition,
2. R. S. Khandpur, (2014) HandbookofBiomedical, Instrumetation, McGraw-Hill PublishingCompany Limited, 3rd edition,.
3. DanielA Vallero, (2013)., Biomedicalethics forEngineers, Elsevierpublication, 2nd edition,
4. Leslie, Cromwell, Fred, J.Weibell,Erich, (2002)BiomedicalInstrumentation andMeasurement, Prentice HallofIndia, New Delhi, 2nd edition,
5. John GWebster, (2010). Medical Instrumentation:,Applicationand Design, John WileyandsonsNewYork, 4th edition.
6. JosephJCarr, John M Brown, (2008), Introduction to Biomedical, EquipmentTechnology, John Wiley& Sons, New York, 4th edition,

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-II

19BEBME241 **Engineering Physics** **7H-5C**

(Theory and lab.)

Instruction Hours/week: L:3 T:1 P:3 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objective:

- To inculcate the basics of properties of matter and its applications.
- To study the basics of sound and ultrasonics with appropriate applications.
- To disseminate the fundamentals of thermal and quantum physics and their applications.
- To introduce the concepts of light, laser and fiber optics for diverse applications.
- To impart the basic knowledge of crystal and its various crystal structures.
- To analyse the relevant problems in engineering stream.

Course Outcomes

Upon completion of this course, the students will be able

- Develop knowledge on the basics of properties of matter and its applications.
- List the concepts of sound, ultrasonics and their applications.
- Analyse the concepts of thermal properties of materials and advanced physics concepts of quantum theory
- Develop knowledge on the basics of light, laser, fiber optics and their applications.
- Understand the basics of crystals and their structures.
- Apply the knowledge gained from this course to solve the relevant problems in engineering stream.

UNIT I - PROPERTIES OF MATTER

Elasticity: Hooke's law, stress-strain diagram – types of moduli of elasticity – basic definitions, relation connecting the moduli (Derivation)-factors affecting elastic modulus and tensile strength–Poisson's ratio- Torsional pendulum- bending of beams - bending moment – uniform and non-uniform bending - I-shaped girders.

UNIT II - ACOUSTICS AND ULTRASONICS

Classification of sound - loudness and intensity - standard intensity and intensity level - decibel - reverberation- reverberation time- sound absorbing materials - factors affecting acoustics of buildings: focusing, interference, echo, echelon effect, resonance, noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - industrial applications – Non-destructive testing- pulse echo system through transmission and reflection modes – scan displays.

UNIT III - THERMAL AND QUANTUM PHYSICS

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media – Forbe's and Lee's disc method: theory and experiment- Introduction to quantum theory – Black body radiation-Laws - dual nature of matter and radiation – de Broglie wavelength, uncertainty principle – Schrödinger's wave equation – time dependent and time independent equations – physical significance of wave function - particle in one dimensional box- degenerate and non-degenerate states.

UNIT IV - APPLIED OPTICS

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO_2 laser - semiconductor lasers: homo junction construction and working, Holography – applications. Optical fibres – classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system, fibre optic sensors.

UNIT V - CRYSTAL PHYSICS

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - interplanar distance for a cubic crystal –Effective number, atomic radius, coordination number and packing factor for SC, BCC, FCC, HCP- crystal imperfections: point defects, line defects, surface defects, Burger's vector.

SUGGESTED READINGS

1. Gaur R.K. and Gupta S.L, (2013) Engineering Physics, Dhanpat Rai Publications.
2. PalanisamyP.K, (2006)Engineering Physics, Scitech Publications (P) Ltd.
3. ArumugamM , (2000)Engineering Physics, Anuradha Publications.
4. SerwayR.A and Jewett J.W, (2010)Physics for Scientists and Engineers with Modern Physics, Thomson Brooks/Cole Publishing Co.
5. Tipler P.A. and MoscaG.P, (2007)Physics for Scientists and Engineers with Modern Physics, W.H.Freeman.
6. MarkertJ.T., Ohanian, H. and Ohanian M., (2007)Physics for Engineers and Scientists, W.W.Norton& Co.

(ii) Laboratory

Course Objective:

- To develop basic laboratory skills and demonstrating the application of physical principles.
- To prepare for the lab experiment and perform individually a wide spectrum of experiments.
- To present experimental data in various appropriate forms like tabulation, and plots.
- To analyze, Interpret and Summarize experimental results.
- To communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
- To understand basic electric circuits.

Course Outcomes:

- The students will have the knowledge on Physics practical experiments and that knowledge will be used by them in different engineering and technology applications.
- Prepare for the lab experiment and perform individually a wide spectrum of experiments.
- Present experimental data in various appropriate forms like tabulation, and plots.
- Analyze, Interpret and Summarize experimental results.
- Communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
- Prepare to develop the skills for understanding basic electric circuits.

LIST OF EXPERIMENTS – PHYSICS

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. Optical fibre -Determination of Numerical Aperture and acceptance angle
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Determination of Band gap of a semiconductor.
11. Spectrometer- Determination of wavelength using grating.
12. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

B.E Biomedical Engineering **2019-2020**

Semester-II

19BEBME242 **Electronic Devices And Circuits (Theory & Lab.)** **6H-5C**

Instruction Hours/week: L:3 T:1 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students :

- To discuss the operational characteristics of a Semiconductor in Equilibrium and Non- Equilibrium conditions.
- To aware with the structure of basic electronic devices.
- To understand the operation and applications of electronic devices.
- To explain the working of PN junction diodes and special purpose diodes.
- To define the basic working of BJT and FET both in ideal and non- ideal conditions.
- To improve knowledge about the working of Rectifiers and Voltage regulators.

COURSE OUTCOMES:

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

- Demonstrate the fundamental concepts of electronic devices
- Build an electronic circuits using transistors.
- Analyze any electronic circuits logically
- Understand the specifications of regulators and power supply circuits.
- Apply positive feedback principle and design oscillators.
- Design multivibrator circuits.

UNIT I - Semiconductor Diodes And Special Purpose Diodes

Semiconductors: Intrinsic semiconductor – extrinsic semiconductor – Fermi level in an intrinsic semiconductor Semiconductor diodes : Formation of PN junction – working principle – VI characteristics – diode current equation – diode resistance – transition and diffusion capacitance. Special purpose diodes: Tunnel, Varactor, Pin contact, Zener diode, schottky diode- Clippers and clampers

UNIT II - Bipolar Transistors

Bipolar Transistors: NPN-PNP- Construction – working – transistor currents –transistor configurations (CB,CE,CC) and input- output characteristics – Early effect (base width modulation) – transistor as an amplifier Transistor as a switch.

UNIT III - Field Effect Transistors

Field-Effect Transistors: construction, working principle and VI characteristics of JFET – comparison of BJT and JFET – MOSFET : working principle and VI characteristics, enhancement MOSFET, depletion MOSFET - comparison of MOSFET with JFET.

UNIT IV - DC Power Supplies

Rectifiers – Half wave, full wave and Bridge -Block schematic of a typical DC power supply, single phase HWR, FWR, filters - ripple factor and efficiency analysis , Voltage regulators: voltage regulation, Zener diode shunt regulator, transistor series regulator, transistor shunt regulator, switching regulators. Low dropout Regulators (LDO)

UNIT V - Oscillators And Multivibrators

Types of Oscillators: RC phase shift, Wein-bridge, Hartley, Colpitt, Crystal; types of multivibrators: Astable, mono and bi-stable.

SUGGESTED READINGS

1. Millman and Halkias, (2010)., Electronic devices and Circuits, Tata McGraw Hill International,
2. David A.Bell (2009).. Fundamental of electronic devices and circuits, Oxford press,
3. Thomas L. Floyd, (2012),Electron Devices, Charles and Messil Publications,
4. G.K.Mithal, 2013Electronic Devices and Circuits, Khanna Publishers,
5. Robert L. Boylestad and Louis Nashelsky, (2009) Electronic Devices and Circuit Theory, Pearson Education, 9th Edition,.

(ii) Laboratory

COURSEOBJECTIVE:

The goal of this course is for students :

- To analyze the Biasing network for BJT and FET, transient analysis and frequency response of BJT and FET in single stage and Oscillator
- To develop the ability to analyze and design analog electronic circuits using discrete components.
- To outline the amplitude and frequency responses of electronic circuits
- To simplify the operation of Oscillators and wave form generators**.**
- Understand the specifications of power supply circuits.
- To understand the concept of AC to DC conversion

COURSE OUTCOME:

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

- Utilize the fundamental concepts of electronic devices
- Build basic electronic circuits with BJT and FET
- Deduct the circuit defects
- Design oscillator circuits
- Understand wave shaping concepts
- Demonstrate halfwave and full wave rectifier.

LIST OF EXPERIMENTS:

1. V-I Characteristics of PN diode
2. V-I Characteristics of Zener diode
3. V-I Characteristics of Clippers and Clampers
4. Input and Output Characteristics of BJT
5. Drain and transfer characteristics of JFET
6. Hartley Oscillator
7. Colpitt Oscillator
8. Astable Multivibrator
9. Half wave rectifier– with and without filter
10. Full wave rectifier – with and without filter

SEMESTER III

19BEBME301A OPTIMIZATION AND CALCULUS OF VARIABLES 3 1 0 4 100

OBJECTIVES:

The goal of this course is for students :

- To develop analytical skills for solving engineering problems
- To teach the students the basic concepts of LPP, Transportation and Assignment problems
- To make the students to study about the Integer Programming and Network Analysis
- To teach the students the basic concepts PERT & CPM
- To teach the students the basic concepts of Hungarian Algorithm
- To make students understand the concept of Branch Bound Method

INTENDED OUTCOMES:

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

- Be able to solve problems in different environments and develop critical thinking
- Be able to build and solve Transportation Models
- Be able to analyse Assignment Models,
- Be able to solve integer programming and Nonlinear programming
- Be able to understand Hungarian Algorithm
- Analyse and apply branch bound method in engineering problems

UNIT I LINEAR PROGRAMMING PROBLEM

Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two phase simplex method. Duality - Dual and simplex method - Dual Simplex Method.

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEM

Transportation Model- finding initial basic feasible solutions- moving towards optimality- Degeneracy.

Solution of an Assignment problem - Hungarian Algorithm.

UNIT III INTEGER PROGRAMMING

Integer Programming Problem – Gromory's fractional cut Method – Branch Bound Method

UNIT IV NETWORK ANALYSIS

PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis.

UNIT V CALCULUS OF VARIATIONS

Calculus of Variations - Basic definition, Simplest problem, Isoperimetric problem, Problems with Higher order derivatives, Euler Lagrange Equation, Weierstrass - Erdmann conditions; Pontryagin Maximum Principle; Transversality condition; Applications

TEXT BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Hamdy Taha. A.	Operations Research	Prentice – Hall of India Private Limited, New Delhi .	2013
2	Dr. Grewal B.S.	Higher Engineering Mathematics	Khanna Publishers, New Delhi.	2013

REFERENCES:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Natarajan A.M., Balasubramani P., Thamilarasi A	Operations Research	Pearson Education, New Delhi.	2005
2	Srinivasan G	Operations Research: Principles and Applications	PHI Private Limited, New Delhi.	2007
3	Winston	Operations Research, Applications and Algorithms	Cengage Learning India Pvt. Ltd, New Delhi.	2004
4	Kanti Swarup,	Operations Research	Sultan Chand &	2010

	Manmohan, Gupta		Sons, New Delhi.	

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME301B LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS

3 1 0 4 100

OBJECTIVES:

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To understand the procedure to solve partial differential equations.
- To give an integrated approach to number theory and abstract algebra
- To provide a firm basis for further reading and study in the subject.

INTENDED OUTCOMES:

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To understand the procedure to solve partial differential equations.
- To give an integrated approach to number theory and abstract algebra, and provide a firm
- basis for further reading and study in the subject.

UNIT I VECTOR SPACES

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT II LINEAR TRANSFORMATION AND DIAGONALIZATION

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of linear transformations - Eigen values and eigenvectors - Diagonalizability.

UNIT III INNER PRODUCT SPACES

Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS

Formation – Solutions of first order equations – Standard types and equations reducible to standard types – Singular solutions – Lagrange‘s linear equation – Integral surface passing through

a given curve – Classification of partial differential equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT V FOURIER SERIES SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Dirichlet‘s conditions – General Fourier series – Half range sine and cosine series - Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

TEXT BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Friedberg, A.H., Insel, A.J. and Spence, L	Linear Algebra‖	Prentice – Hall of India Private Limited, New Delhi .	2004
2	Dr. Grewal B.S.	Higher Engineering Mathematics	Khanna Publishers, New Delhi.	2014
3	Burden, R.L. and Faires, J.D	"Numerical Analysis", 9th Edition	Cengage Learning	2016
4	James, G	Advanced Modern Engineering Mathematics	Pearson Education	2007
5	Kolman, B. Hill, D.R	Introductory Linear Algebra‖	Pearson Education, New Delhi	2009
6	Kumaresan, S	Linear Algebra – A Geometric Approach	Prentice – Hall of India, New Delhi, Reprint	2010
7	Lay, D.C	Linear Algebra and its Applications	5th Edition, Pearson Education	2015
8	O‘Neil, P.V	Advanced Engineering Mathematics‖	Cengage Learning	2007
9	Strang, G	Linear Algebra and its applications‖	Thomson (Brooks/Cole), New Delhi	2005
10	Sundarapandian, V.	Numerical Linear Algebra‖	Prentice Hall of India, New Delhi	2008

REFERENCE BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	T.S.Blyth.,E.F.Robertson	Basis Linear Algebra	Springer	2002

19BECC302 DIGITAL ELECTRONICS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To explain the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the design of various combinational digital circuits using logic gates
- To illustrate the concept of synchronous sequential circuits
- To bring out the analysis and design procedures for asynchronous sequential circuits
- To summarize the concept of memories and programmable logic devices.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Demonstrate the methods for simplifying Boolean expressions
- Design various combinational digital circuits using logic gates.
- Use Boolean algebra and apply it to digital systems.
- Explain the formal procedures for the analysis and design of combinational circuits and sequential circuits
- Interpret the concept of synchronous and asynchronous sequential circuits
- Apply the concept of memories and programmable logic devices.

UNIT-I NUMBER SYSTEMS AND BOOLEAN ALGEBRA

Binary, Octal, Decimal, Hexadecimal-Number base conversions – complements – signed Binar y numbers. Binar y Arithmetic- Binar y codes: Weighted –BCD-Gray code-Excess 3 code-ASCII – Error detecting code – conversion from one code to another-Boolean postulates and laws –De-Morgan's Theorem- Principle of Duality- Boolean expression – Boolean function-Minimization of Boolean expressions – Sum of Products (SOP) –Product of Sums (POS)-Minterm- Maxterm- Canonical forms – Conversion between canonical forms –Karnaugh map Minimization – Don't care conditions.

UNIT-II LOGIC GATES AND COMBINA TIONAL CIRCUITS

LOGIC GATES: AND, OR, NOT, NAND, NOR, Exclusive – OR and Exclusive – NOR-Implementations of Logic Functions using gates, NAND –NOR implementations –Multi level

gate implementations.

COMBINATIONAL CIRCUITS: Design procedure – Adders-Subtractors – Serial adder/ Subtractor - Parallel adder/ Subtractor- Carr y look ahead adder- BCD adder- Magnitude Comparator- Multiplexer/ Demultiplexer- encoder / decoder – parit y checker. Implementation of combinational
logic using MUX.

UNIT-III SEQUENTIAL CIRCUITS

Flip flops SR, JK, T, D and Master slave – Characteristic table and equation– Edge triggering – Level Triggering –Realization of one flip flop using other flip flops –Asynchronous– Synchronous counters –Classification of sequential circuits – Moore and Meal y -Design of Synchronous counters: state diagram- State table –State minimization –State assignment- Register – shift registers- Universal shift register

UNIT-IV ASYNCH RONOUS SEQUENTIAL CIRCUITS

Design of fundamental mode and pulse mode circuits – primitive state / flow table – Minimization of primitive state table –state assignment – Excitation table – Excitation map- cycles – Races – Hazards: Static –Dynamic –Essential –Hazards elimination.

UNIT-V MEMORY DEVICES

Classification of memories –RAM organization– Static RAM Cell-Bipolar RAM cell – MOSFET RAM cell –Dynamic RAM cell –ROM organization - PROM –EPROM –EEPROM – Programmable Logic Devices – Programmable Logic Array (PLA)- Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

TEXT BOOKS:

S.No.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Morris Mano.M	Digital Design	Prentice Hall of India Pvt. Ltd., New Delhi	2003
2	John M .Yarbrough	Digital Logic Applications and Design	Thomson- Vikas publishing house, New Delhi	2002

REFERENCES:

S.No.	Author(s) Name	Title of the book	Publisher	Year of publication

1	Salivahanan.S and Arivazhagan.S	Digital Circuits and Design	Vikas Publishing House Pvt. Ltd, New Delhi	2004
2	Charles H.Roth	Fundamentals of Logic Design	Thomson Publication Company, New Delhi.	2003
3	Donald P.Leach and Albert Paul Malvino	Digital Principles and Applications	Tata McGraw Hill Publishing Compan y Limited, New Delhi	2003
4	Jain.R.P	Modern Digital Electronics	Tata McGraw–Hill publishing compan y limited, New Delhi	2003
5	Thomas L. Flo yd	Digital Fundamentals	Pearson Education, New Delhi	2003

WEBSITES:

1. www.allaboutcircuits.com/vol_2/chpt_9/2.html
2. www.educypedia.be/electronics/digital.html
3. www.nptel.com
4. www.mit.edu

19BEBME303 C++ AND DATA STRUCTURES 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students:

- To analyse Object Oriented Programming concepts and basic characteristics of C++
- To design problem solutions using Object Oriented Techniques.
- To infer the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a C++ application with threads and generics classes
- To design and build simple Graphical User Interfaces

INDENTED OUTCOME:

Upon completion of this course, the student will be able to

- Utilize a simple Java programming environment, compile programs and interpret compiler errors.
- Distinguish and use the fundamental data types.
- Design classes and organise them into packages.
- Utilize the basic data structures.
- Compare the basic search and sort algorithms.
- Apply appropriate data structure and algorithm to solve a problem.

UNIT – I INTRODUCTION TO DATA STRUCTURES

Abstract data types – Arrays – Static, Dynamic and Generic arrays. Strings – Fixed and variable size – static and dynamic strings.

UNIT – II LINKED LISTS

Dynamic storage management – singly and doubly linked list – Stack – Application of stack – Fixed, variable and Generic stack – queues – queue based on Dynamic linked list – Trees – Binary Trees – Graphs – Warshall's Algorithms – Shortest paths.

UNIT – III OBJECTS ORIENTED PROGRAMMING

Objects and classes – methods, messages, encapsulation, abstraction, inheritance, polymorphism, dynamic building. Traditional approach Versus object orientation; benefits of object orientation – flexibility in software development – reusability – extensibility – maintainability.

UNIT – IV OBJECTS AND CLASSES

Specifying classes – using – C++ objects and data types – constructors and destructors – object as function arguments – structures and classes. Array fundamentals – array as class member data – array of objects. Structures – simple structure – accessing structure member – structure within structure – structure and classes – Function overloading – Inline function – Virtual function and polymorphism.

UNIT – V OPERATOR OVERLOADING

Overloading unary operator – overloading binary operator – data conversion. Inheritance – derived class and base class – derived class constructors – public and private inheritance – level of inheritance. C++ graphics – text – mode graphics functions – graphics – mode graphics functions – colors – rectangles and lines – polygons and inheritance – text in graphics mode – Addresses and pointers, Simple file operations: streams – string I/O – character I/O.

TEXT BOOKS:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	N.S. Kutti and P.Y. Padhye	Data Structures in C++	Prentice Hall of India Pvt., Ltd., New Delhi	2001
2	Liberty & Keogh	C++: An introduction to programming	Prentice Hall of India Pvt., Ltd., New Delhi	2002

REFERENCES:

S. NO.	AUTHOR(S) NAME	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1	Bjarne Stroustrup	The C++ Programming Language	Addison Wesley by publication, New York	1994
2	Jean – Paul Tremblay and Paul G.Sorenson	An Introduction to Data Structures with Applications	Tata McGraw Hill	1998
3	E. Balagurusamy	Object oriented Programming with C++	Tata McGraw Hill, New Delhi	1996

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME304 MEDICAL PHYSICS 3 0 0 3 100

OBJECTIVES:

The Goal of this course is for students:

- To study the complete non-ionizing radiations including light and its effect in human body.
- To demonstrate the principles of ultrasound radiation and its applications in medicine.
- To appraise about radioactive nuclides and also the interactions of radiation with matters and how isotopes are produced.
- To perceive the role of Physics in cardiopulmonary system.
- To analyse the harmful effects of radiation and radiation protection regulations.
- To study the effects of sound and light in human body

INTENDED OUTCOMES:

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

- Analyze the low and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasound wave.
- Explain the process of radioactive nuclide production using different techniques.
- Analyze radiation mechanics involved with various physiological systems.
- Apply the concept of physics in the function of cardiopulmonary system.
- Outline the detrimental effects of radiation and regulations for radiation safety.

UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION

Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light, Measurement of light and its unit-limits of vision and color vision an overview, Thermography– Application

UNIT II SOUND IN MEDICINE

Physics of sound, Normal sound levels –ultrasound fundamentals – Generation of ultrasound

(Ultrasound Transducer) - Interaction of Ultrasound with matter; Cavitations, Reflection, Transmission- Scanning systems – Artifacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications

UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-fission and electron Capture reaction, radionuclide Generator-Technetium generator.

UNIT IV INTERACTION OF RADIATION WITH MATTER

Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

UNIT V BASIC RADIATION QUANTITIES

Introduction -exposure- Inverse square law-KERMA-Kerma and absorbed dose –stopping power - relationship between the dosimetric quantities - Bremsstrahlung radiation, Bragg's curve- concept of LD 50- Stochastic and Non-stochastic effects, Different radiation Unit, Roentgen, gray, Sievert.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	John R Cameran , James G Skofronick	Medical Physics	John-Wiley & Sons	1978
2	W.J.Meredith and J.B. Massey	Fundamental Physics of Radiology	Varghese Publishing house	1992

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	P.Uma Devi, A.Nagarathnam , B S SatishRao	Intorduction to Radiation Biology	B.I ChurChill Livingstone pvt Ltd	2000
2	S.Webb	The Physics of Medical Imaging	Taylor and Francis	1988
3	J.P.Woodcock	Ultrasonic,Medical Physics Handbook series	Adam Hilger,Bristol	2002

4	Hylton B.Meire and Pat Farrant	Basic Ultrasound	John Wiley& Sons	1995

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME305 FUNDAMENTALS OF BIOCHEMISTRY 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To study about the biochemistry of living cells, metabolism of biomolecules and the methods of investigation and diagnostic tools.
- To summarize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules.
- To analyse the structural and functional properties of carbohydrates, proteins and lipids
- To discuss about functions of each organelles and Transport of substances across biological membranes
- To infer about the biochemistry of living cells
- Demonstrate the concepts of biochemistry of living cells

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Demonstrate the concepts of biochemistry of living cells
- Understand the concepts of protein biochemistry
- Explain about functions of each organelles and Transport of substances across biological membranes
- Illustrate the structural and functional properties of carbohydrates, proteins and lipids
- Perceive the concepts of investigation of metabolism.
- Understand the structural and functional properties of various organelles and biomolecules

UNIT I BIOCHEMISTRY OF LIVING CELLS

Biochemistry of living cells, sub cellular fractionation using the differential centrifugation method. Functions of each organelles, redox potential, oxidative phosphorylation, Transport of substances across biological membranes.

UNIT II CARBOHYDRATES

Carbohydrates: Definition, classification, biological functions; glycolysis, TCA cycle, glycogenesis, glycogenolysis, Diabetes Mellitus – Blood Sugar analysis and glucose tolerance test.

UNIT III PROTEINS

Proteins: Definition, classification, architecture, biological functions; Classification of amino acids, Oxidative and non oxidative deamination, transamination, decarboxylation, urea cycle, Purification of proteins.

UNIT IV LIPIDS

Lipids: Definition, classification, biological functions; biosynthesis of long chain fatty acids, degradation of fatty acids - oxidation of fatty acids.

UNIT V METHODS OF INVESTIGATION OF METABOLISM

Liver function tests, Real function tests, Gastric function tests. Diagnostic tools: Principles and applications of photometry, spectrophotometry, flurometry, flame photometry, automation in clinical laboratory. Uses of isotopes in biochemistry.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Lehninger.A .L., Nelson D.L., Cox .M.M.,	Principles of Biochemistry	CBS Publications	1993

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kumar V., & Gill, K. D.	Basic concepts in clinical biochemistry: Apractical Guide	Springer, Singapore	2018
2	. Ambiga Shanmugam	Fundamentals of Biochemistry for Medical Students	Karthick Printers, Madras	1997

3	Varley	Clinical Biochemistry	CBS Publications	1988

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME306 ANATOMY AND HUMAN PHYSIOLOGY 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students

- To discuss all the organelles of an animal cell and their function.
- To perceive structure and functions of the various types of systems of human body.
- To outline about eye, ear and Endocrine glands of human
- To learn organs and structures involving in system formation and functions.
- To understand all systems in the human body.
- To infer basic understanding of the interconnection of various organ systems in human body

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Explain basic structure and functions of cells and its organelles
- Demonstrate about anatomy and physiology of various organ systems
- Illustrate eye, ear and Endocrine glands of human
- Explain the interconnect of various organ systems in human body
- Enlighten organs and structures involving in system formation and functions.
- Elucidate special senses in the human body.

UNIT I CELL

Structure of Cell – Organelles and description – Function of each component of the cell – Membrane potential – Action Potential – Generation and Conduction – Electrical Stimulation. Blood Cell – Composition – Origin of RBC – Blood Groups – Estimation of RBC, WBC and Platelet.

UNIT II CARDIAC AND NERVOUS SYSTEM

Heart, Major blood vessels – Cardiac Cycle – ECG – Blood Pressure – Feedback Control for Blood Pressure – Nervous Control of Heart - Cardiac output – Coronary and Peripheral Circulation – Structure and function of Nervous tissue – Neuron - Synapse - Reflexes - Receptors -Brain -Brainstem -Spinal cord – Reflex action – Velocity of Conduction of Nerve Impulses - Electro Encephalograph – Autonomic Nervous System.

UNIT III RESPIRATORY SYSTEM AND MUSCULO SKELETAL SYSTEM

Physiological aspects of respiration – Trachea and lungs - Exchange of gases – Regulation of Respiration - Disturbance of respiration function - Pulmonary function test - Muscles - tissue - types - structure of skeletal muscle - types of muscle and joints.

UNIT IV DIGESTIVE AND EXCRETORY SYSTEM

Organisation of GI System, Digestion and absorption – Movements of GI tract – Intestine - Liver - Pancreas - Structure of Nephron – Mechanism of Urine formation – Urine Reflex – Skin and Sweat Gland – Temperature regulation.

UNIT V EYE, EAR, ENDOCRINE GLANDS

Optics of Eye – Retina – Photochemistry of Vision – Accommodation - Neurophysiology of vision – EOG. Physiology of internal ear – Mechanism of Hearing – Auditory Pathway, Hearing Tests - Endocrine glands.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sarada Subramanyam, K.Madhavan Kutty and H.D.Singh	Text Book of 'Human Physiology	S.Chand & Company	1996
2	Ranganathan, T.S	Text Book of Human Anatomy	S.Chand &Co. Ltd., Delhi	1996

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tobin, C.E.,	Basic Human Anatomy	McGraw-Hill Publishing Co. Ltd.,	1997
2	J.Gibson	Modern Physiology and Anatomy for Nurses	Blackwell SC Publishing	1981
3	Arthur.C.Guyton	John E Hall – ,Textbook of Medical Physiology	W.B. Saunders Company	2000

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME311 BIOCHEMISTRY AND HUMAN PHYSIOLOGY LAB 0 0 4 2 100

OBJECTIVE:

The goal of this course is for students

- To estimate and quantify biomolecules.
- To divide amino acid molecules
- To evaluate and interpret of biochemical parameter
- To understand differential count of WBCs
- To understand the Ishihara chart
- To understand the auditory conduction

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Solve the quantitative test of different biomolecules
- Label the separation technology of proteins and amino acids.
- Analyse blood group
- Estimate of blood glucose
- Estimation of Hemoglobin
- Perceive the Biochemistry laboratory functional parameters

LIST OF EXPERIMENTS:

1. General tests for carbohydrates, proteins and lipids.
2. Preparation of serum and plasma from blood.

3. Estimation of blood glucose.
4. Estimation of serum cholesterol.
5. Estimation of creatinine in urine.
6. Separation of amino acids using thin layer chromatography.
7. Estimation of Hemoglobin
8. Differential count of different WBCs and Blood group identification
9. Ishihara chart for color blindness and Snellen's chart for myopia and hyperopia – by letters reading and opthalmoscope to view retina.
10. Weber's and Rinnee's test for auditory conduction.

19BEBME312 DIGITAL ELECTRONICS LABORATORY 0 0 4 2 100

OBJECTIVE:

The goal of this course is for students

- Learn the basics of gates.
- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- Learn about counters
- Learn about Shift registers
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Analyse different methods used for simplification of Boolean expressions.
- Design and implement Combinational circuits.
- Design and implement synchronous and asynchronous sequential circuits.
- Interpret the concept of synchronous and asynchronous sequential circuits
- Implement shift registers using Flip-flops.
- Apply the knowledge on digital circuits design

LIST OF EXPERIMENTS:

1. Study of logic gates.

2. Design and implementation of adders and Subtractors using logic gates.
3. Design and implementation of code converters using logic gates BCD to excess-3 code
4. Design and implementation of 4 bit binary Adder/Subtractor and BCD adder using IC 7483.
5. Design and implementation of 2 bit Magnitude Comparator using logic gate 8 bit Magnitude Comparator using IC 7485.
6. Design and implementation of 16 bit odd/even parity checker generator using IC74180.
7. Design and implementation of Multiplexer and Demultiplexer using logic gates and study of IC74150 and IC74154.
8. Design and implementation of encoder and Decoder using logic gates and study of IC 7445 and IC 74147.
9. Construction and verification of 4 bit ripple counter and Mod-10/ Mod- 13 Ripple counters.
10. Design and implementation of 3 bit Synchronous up/down counter.
11. Implementation of SISO, SIPO,PISO and PIPO shift registers using Flip-flops.

19BEBME313 COURSE ORIENTED PROJECT – I 0 0 2 1 100

19BEBME351 SOFT SKILLS FOR BIOMEDICAL ENTREPRENEURS 1 0 0 - 100

Course Objectives :

- To encourage the all round development of students by focusing on soft skills.
- To make the engineering students aware of the importance, the role and the content of soft skills
- To give instruction, knowledge acquisition, demonstration and practice on soft skills
- To develop and nurture the soft skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioural aspects
- To build the right attitudinal through activities

Course Outcomes:

On completion of the course, student will be able to

- Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents .

- Actively participate in group discussion / meetings / interviews and prepare & deliver presentations .
- Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Function effectively in multi-disciplinary and heterogeneous teams
- Handle team work, Inter-personal relationships, conflict management and leadership quality.

People skills – social skills – communication skills – character traits – attitudes – career attributes – emotional intelligence coefficient – common sense – cognitive or emotional empathy– interpersonal skills – courtesy – flexibility – integrity – interpersonal skills – positive attitude – professionalism – responsibility – team work – work ethics.

SEMESTER IV

19BEBME401 PROBABILITY AND STATISTICS 3 1 0 4 100

OBJECTIVES:

The goal of this course is for students

- This course aims at providing the required skill to apply the statistical tools in Engineering problems.
- To introduce the basic concepts of probability.
- To introduce the basic concepts of random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To understand the notion of sampling distributions and statistical techniques
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

.

INTENDED OUTCOME:

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

- Explain the fundamental concepts of probability and standard distributions which can describe real life phenomenon.

- Explain the basic concepts of one- and two-dimensional random variables and their applications in engineering.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Discuss the notion of sampling distributions and statistical techniques used in engineering and management problems.
- Discuss about the techniques in quality control that model engineering problems.

UNIT- I PROBABILITY

Probability – Definition – Law - conditional probability-Bayes theorem- Probability mass function - Probability density functions.

UNIT- II RANDOM VARIABLES

Introduction to one dimensional random variables – Discrete – Continuous - Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression.

UNIT- III TESTING OF HYPOTHESIS

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions – Tests for independence of attributes and Goodness of fit.

UNIT – IV DESIGN OF EXPERIMENTS

Analysis of variance – one way classification – CRD – Two-way classification – RBD – Latin square.

UNIT – V RELIABILITY AND QUALITY CONTROL

Concepts of reliability – hazard functions – Reliability of series and parallel systems – control charts for measurement ($\bar{X}$ *and* R *charts*) - Control charts for attributes (p, c and np charts).

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Rao V Dukkipati	• Probability and Statistics for Scientists and Engineers	New Age International Publishers	2010
2	J. Susan Milton .,Jesse C. Arnold	• Introduction to Probability and Statistics	McGraw-Hill	2002

REFERENCES:

S. NO.	AUTHOR(S)	TITLE OF THE	PUBLISHER	YEAR OF

	NAME	BOOK		PUBLICATION
1	P.S.S.Sundar Rao and J.Richard	Introduction to Biostatistics and Research Methods	Prentice Hall of India, New Delhi.	2012
2	R.A.Johnson and C.B.Gupta	Miller and Freund's Probability and Statistics for Engineers	Pearson Education Asia, New Delhi.	2007
3	S.C.Gupta and V.K.Kapoor	Fundamentals of Applied Statistics	Sultan Chand & Sons, New Delhi	2007

WEBSITES:

1. www.cut-theknot.org/probability.shtml
2. www.mathcentre.ac.uk
3. www.mathworld.

19BEBME402 LINEAR INTEGRATED CIRCUITS 3 0 0 3 100

OBJECTIVES:

COURSE OBJECTIVES:

The goal of this course is for students :

- To discuss the basic concepts of linear integrated circuits
- To study the circuit configuration and introduce practical applications of linear integrated circuits.
- To introduce the concept of Passive and Active filters
- To infer the theory and applications of PLL
- To make use of the theory of ADC and DAC using OP – AMPS
- To demonstrate the concepts of waveform generation and introduce some special function ICs

INTENDED OUTCOMES:

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

- Define linear and non linear applications of OP – AMPS
- Create waveforms using OP – AMP Circuits
- Ability to design new analog linear circuits and develop linear IC based Systems.
- Understand the concept of application of waveform generators

- Design ADC and DAC using OP – AMPS
- Analyze special function ICs

UNIT I OPERATIONAL AM PLIFIER CHARACTERISTICS

Op-amp - Block diagram Representation of op-amp- Open loop & closed loop configurations – DC & AC performance characteristics of op-amp – Frequency compensation - Noise – Differential amplifiers -Electrical Characteristics and internal schematic of 741 op - amps.

UNIT II OPAMP APPLICATIONS

Inverting & Non-inverting voltage amplifiers -Voltage follower –Summing & averaging amplifiers - AC amplifiers, Instrumentation Amplifiers-V-to-I and I-to-V converters-Differentiators and Integrators. Wave Shaping Circuits - Clipper and Clampers–Comparators and its applications.

UNIT III WAVEFORM GENERATORS AND PLL

Waveform Generators: Sine-wave Generators – Square / Triangle / Sawtooth Wave generators. IC 555 Timer: Monostable operation and its applications, Astable operation and its applications P LL: Operation of the Basic P LL-Closed loop analysis of P LL-Voltage Controlled Oscillator-PLL Applications

UNIT IV ACTIVE FILTERS & VOLTAGE REGULATOR

Filters: Passive and Active Networks – Filter Approximations-Design of LPF, HPF, BPF and Band Reject Filters , Voltage Regulators: Basics of Voltage Regulator – Linear Voltage Regulators using Op-amp – IC Regulators (78x x, 79xx, LM 317, 723)-Switching Regulators.

UNIT V DATA CONVERSION DEVICES

DAC circuits: Weighted Resistor DAC, R-2R Ladder DAC- Inverted R-2R Ladder DAC Monolithic DAC; Analog to Digital conversion: Ramp Type ADC-Successive Approximation ADC-Dual Slope ADC-Flash Type ADC.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Roy Choudhur y and Shail Jain	Linear Integrated Circuits	New Age International Publishers	2003
2	Ramakant A.Ga yakwad	Op-Amps and Linear Integrated Circuits	Prentice Hall of India, New Delhi	2000

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Robert F. Coughlin, Frederick F. Driscoll	Operational-Amplifiers and Linear Integrated Circuits	Prentice Hall of India, New Delhi	2001
2	Sergio Franco	Design with operational amplifier and analog integrated circuits	McGraw Hill	2015

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME403 BIOSENSORS AND TRANSDUCERS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To define the basic concepts such as generalized instrumentation system, general properties of input transducers, static and dynamic characteristics of transducers and sensors
- To perceive a thorough understanding of principle of sensors
- To know the principle of transduction, classifications and the characteristics of different transducers
- To create the biomedical applications of the transducers and sensors.
- To discuss working of some of the above transducers and sensors.
- To know the different display and recording devices.

INTENDED OUTCOMES :

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

- Have a clear understanding of generalized medical instrumentation system, general properties of input transducers, static and dynamic characteristics of transducers and sensors.
- Demonstrate various transducers and sensors in the course.
- Describe the purpose and methods of measurements.
- Explain the principle of different sensors and its applications
- Apply the transducers and sensors learnt in the course in suitable medical contexts.
- Implement working knowledge of some of the transducers and sensors

UNIT I INTRODUCTION TO TRANSDUCERS AND ITS CHARACTERISTICS

Introduction: Generalized Instrumentation System, General Properties of Input Transducer Static Characteristics: Accuracy, Precision, Resolution, Reproducibility, Sensitivity, Drift, Hysteresis, Linearity, Input Impedance and Output Impedance. Dynamic Characteristics: First Order and Second Order Characteristics, Time Delay, Error Free Instrument, Transfer Functions. Design Criteria, Generalized Instrument Specifications.

UNIT II MEASUREMENTS

Displacement, motion and Pressure Measurement: (with applications) Resistive: Potentiometers, Strain Gauges and Bridge Circuits. Inductive: Variable Inductance and LVDT Capacitive type, Piezoelectric Transducers. Types of Diaphragms, Bellows, Bourdon Tubes.

UNIT III THERMAL MEASUREMENTS

Temperature Measurement: Thermistor, Thermocouple, Resistive Temperature Detector, IC based Temperature Measurement, Radiation Sensors and Applications .

UNIT IV ELECTRODES

Biopotential Electrodes: Electrodes Electrolyte Interface, Half-Cell Potential, Polarization, Polarizable and Non Polarizable, Electrodes, Calomel Electrode, Electrode Circuit Model, Electrode Skin-Interface and Motion Artifact. Body Surface Electrodes. Internal Electrodes: Needle and Wire Electrodes (Different Types). Microelectrodes: Metal, Supported Metal Micropipette (Metal Filled Glass And Glass Micropipette Electrodes)

UNIT V BIOSENSORS

Chemical Sensors: Blood gas and Acid- Base Physiology Potentiometric Sensors, Ion Selective Electrodes, ISFETS. Ampero metric Sensors, Clark Electrode with examples - pH, pO2, pCO2 Electrodes, Transcutaneous Arterial Oxygen Tension, Carbon Dioxide measurements: capnostat. Fiber Optic Sensors: Design Principles in Fabrication of Fiber Optic Sensors - Temperature, Chemical, Pressure. Biosensor: Classifications: Biological phenomenon, Transduction Phenomenon i.e. Enzyme Sensor and Electrode based: Affinity Sensors (Catalytic Biosensors), Two examples of each Biosensors and Immunosensors.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Hermann K P. Neubert	Instrument Transducer – An Intro to their performance and	Hermann K P. Neubert	2000
2	Harry N, Norton.	Biomedical sensors – fundamentals and application	Harry N, Norton.	2001
3	Tatsuo Togawa, Toshiyo Tamma and P. Ake Öberg	Biomedical Transducers and Instruments	Tatsuo Togawa,	1994
4	Nandini K	Electronics in Medicine and Biomedical Instrumentation	Jog PHI Second Edition	2013

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	La Geddes and L.E. Baker	Principles of applied Biomedical Instrumentation	La Geddes and L.E. Baker	1997
2	Leslie Cromwell, Fred. J. Weibell and Pfeiffer	Biomedical instrumentation and measurement	Leslie Cromwell, Fred. J. Weibell and Pfeiffer	2002
3	Richard Aston	Principles of Biomedical Instrumentation and Measurement	Merril Publishing Co., Columbus	1990
4	Jacob Fraden	Handbook of Modern Sensors – Physics, Design and Application	AIP press	2000

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME404 MICROPROCESSOR AND MICROCONTROLLER 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students :

- To infer processor architecture and its programming
- To discuss interfacing concepts
- To appraise advanced processor architecture
- To utilize the concepts of Interfacing with Peripherals for building applications
- To demonstrate the concepts Reduced Instruction Set Computer (RISC) architecture and Advanced RISC Machine (ARM) architecture.
- To develop skill to explore system design technique .

INTENDED OUTCOMES:

At the end of this course students will demonstrate the ability to

- Design assembly language programming (ALP) for different applications for 8085
- Compile assembly language programming (ALP) for different applications for 8086
- Perceive knowledge on advanced processors and controllers
- Create application by Interfacing memory and I/O device with controllers
- Demonstrate the architectures of Reduced Instruction Set Computer (RISC) and Advanced RISC Machine (ARM) processors

- Design and deploy the Interfacing peripherals in real time scenario.

UNIT -I THE 8085 MICROPROCESSOR

Introduction to 8085 – Microprocessor architecture – Instruction set – Programming the 8085 – Code conversion.

UNIT II THE 8086 MICROPROCESSOR

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT III I/O INTERFACING

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT IV MICROCONTROLLER

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming.

UNIT V INTERFACING MICROCONTROLLER

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Yu-Cheng Liu, Glenn A.Gibson	Microcomputer Systems: The 8086 / 8088 Family Architecture, Programming and Design	Second Edition, Prentice Hall of India	2007
2	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Second Edition, Pearson education	2011

REFERENCE:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Doughlas V.Hall	Microprocessors and Interfacing, Programming and Hardware	TMH	2012

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME405 ENVIRONMENTAL STUDIES 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students :

- To create the awareness about environmental problems among people.
- To develop an attitude of concern for the environment.
- To motivate public to participate in environment protection and improvement.
- To relate critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.

INTENDED OUTCOME:

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

- Demonstrate core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Identify concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- Distinguish the ethical, cross-cultural, and historical context of

environmental issues and the links between human and natural systems.

- Analyse the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
- Recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- Identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.

UNIT I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS **9**

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grass and Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II - NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES **9**

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources -Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT III - BIODIVERSITY AND ITS CONSERVATION **9**

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio- geographical classification of India. Biodiversity patterns (global, National and local levels). Hot- spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India.Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT IV - ENVIRONMENTAL POLLUTION **9**

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban, industrial and e-wastes. Role of an individual in prevention of pollution. Case studies.

UNIT V - SOCIAL ISSUES AND THE ENVIRONMENT **9**

Concept of sustainability and sustainable development. Water conservation -Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols).Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides).Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).Human population growth: Impacts on environment, human health and welfare

Total periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Anubha Kaushik., and Kaushik, C.P	Perspectives in Environmental Studies	New Age International Pvt.	2004
2	Arvind Kumar.	A Textbook of Environmental Science	APH Publishing Corporation,	2004
3	Mishra, D.D	Fundamental Concepts in Environmental Studies	S.Chand& CompanyPvt. Ltd	2010
4	Daniel, B. Botkin., and Edward, A. Keller	Environmental Science	John Wiley and Sons, Inc	1995

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Odum,E.P., Odum , H.T. and Andrews, J	Fundamentals of Ecology	Philadelphia: Saunders.	1971
2	Rajagopalan, R	Environmental Studies: From Crisis to Cure	Oxford University Press	2016

3	Sing, J.S., Sing. S.P. and Gupta, S.R.	Ecology, Environmental Science and Conservation	Chand & Publishing Company	2014
4	Singh, M.P., Singh, B.S., and Soma, S. Dey	Conservation of Biodiversity and Natural Resources	Daya Publishing House	2004
5	Tripathy.S.N., and Sunakar Panda	Fundamentals of Environmental Studies (2nd ed.)	Vrianda Publications Private Ltd	2004
6	Verma, P.S., and Agarwal V.K.	Environmental Biology (Principles of Ecology).	S.Chand and Company	2001
7	Uberoi, N.K.	Environmental Studies.	Excel Books Publications	2005

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME406 ANALOG AND DIGITAL COMMUNICATION 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students :

- To understand analog and digital communication techniques.
- To learn data and pulse communication techniques.
- To be familiarized with source and Error control coding.
- To create the awareness about pulse and data communication.
- To develop knowledge digital communication.
- To impart knowledge on the multi-user radio communication.

INTENDED OUTCOME:

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

- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.
- Gain knowledge on multi-user radio communication.
- Demonstrate core concepts and methods of source and error control coding
- Identify concepts the multi-user radio communication.

UNIT I ANALOG COMMUNICATION

Introduction to Communication Systems - Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II PULSE AND DATA COMMUNICATION

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM). Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Data communication Hardware - serial and parallel interfaces.

UNIT III DIGITAL COMMUNICATION

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV SOURCE AND ERROR CONTROL CODING

Channel capacity, Error Control Coding, linear block codes, cyclic codes - ARQ Techniques.

UNIT V MULTI-USER RADIO COMMUNICATION

Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Wayne Tomasi	Advanced Electronic Communication Systems‖	6th Edition, Pearson Education	2009

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Simon Haykin	Communication Systems‖	4th Edition, John Wiley & Sons	2004
2	Rappaport T.S	Wireless Communications: Principles and Practice	2nd Edition, Pearson Education	2007

3	H.Taub, D L Schilling and G Saha	Principles of Communication	3rd Edition, Pearson Education	2007
4	B. P.Lathi	Modern Analog and Digital Communication Systems‖	3rd Edition, Oxford University Press	2007
5	Blake	Electronic Communication Systems‖	Thomson Delmar Publications	2002
6	Martin S.Roden	Analog and Digital Communication System‖	3rd Edition, Prentice Ha of India	2002

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME411 MICROPROCESSOR & MICROCONTROLLER LABORATORY 0032 100

OBJECTIVES:

The goal of this course is for students :

- To introduce ALP concepts and features
- To design and implement programs on 8085 microprocessor
- To write ALP for arithmetic and logical operations in 8086 and 8051
- To differentiate Serial and Parallel Interface
- To interface different I/Os with Microprocessors
- To be familiar with MASM

INTENDED OUTCOME:

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

- Write ALP Programmes for fixed and Floating Point and Arithmetic operations
- Interface different I/Os with processor
- Generate waveforms using Microprocessors
- Execute Programs in 8051
- Use Serial and Parallel Interface

- Perform A/D and D/A conversion

LIST OF EXPERIMENTS:

8085 Programs using kits

1. Basic arithmetic and Logical operations
2. Sorting and searching

8086 Programs using kits

3. Basic arithmetic and Logical operations
4. Code conversion, decimal arithmetic and Matrix operations.
5. Floating point operations, string manipulations, sorting and searching

Peripherals and Interfacing Experiments

6. Traffic light control
7. Stepper motor control
8. Key board and Display
9. Serial interface and Parallel interface
10. A/D and D/A interface and Waveform Generation

8051 Experiments using kits and MASM

11. Basic arithmetic and Logical operations
12. Code conversion

19BEBME412 BIOSENSORS AND TRANSDUCERS LAB 0 0 3 2 100

OBJECTIVES:

The goal of this course is for students,

- To learn about data acquisition of physiological signal
- To learn about various biosensors
- To distinguish contact and non-contact method of skin temperature measurement
- To discuss working principle of Transducers
- To experiment with basic functions of Biosensors.
- To make use of different physiological signals.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Interpret the characteristics of various biosensors
- Illustrate the importance of the sensors and transducers for medical applications.
- Analyse the characteristics of physiological signals

- Measure skin temperature
- Perform data acquisition of physiological signals
- Choose the biosensors for relevant application

LIST OF EXPERIMENTS

1. Study of Biological Sensors
2. Displacement measurement using LVDT
3. Characteristics of temperature sensors – thermistor and RTD.
4. Characteristics of thermocouple
5. Characteristics of Flow Transducer
6. Characteristics of photo diodes, phototransistor
7. Characteristics of Piezoelectric Transducer.
8. Data acquisition of physiological signals
9. Measurement of skin temperature by both contact and non-contact method.
10. Study of the characteristics of capacitor level sensor for saline level measurement in a I-V set.

19BEBME451 HANDS ON TRAINING IN BIOMEDICAL EQUIPMENTS 0 0 1 100

OBJECTIVE:

- To gain the knowledge on various electronic equipments
- To learn the working principle of voltmeter
- To learn the working principle of digital voltmeter
- To discuss the working principle of Ammeter
- To distinguish analog multimeter digital multimeter
- To understand the operation of function generator

OUTCOME:

- Understand the working of various electronic equipments
- Analyse the operations of voltmeter and Ammeter
- Use RLC meter and LCR meter
- Understand the applications of EMF meter

- handle analog multimeter digital multimeter
- Demonstrate the operation of function generator

Study of Voltmeter – Ammeter – ohmmeter – capacitance meter – regulated power supply – oscilloscope – function generator – time-domain reflectometer – digital voltmeter – digital counter – Analog multimeter & Digital multimeter – Signal injector – RLC meter – LCR meter – EMF meter – Electrometer -

SEMESTER V

19BEBME501	**BIO CONTROL SYSTEM**	**3 1 0 4**	**100**

OBJECTIVE:

The goal of this course is for students :

- To analyse the systems in time and frequency domain
- To understand the concept of stability
- To acquire knowledge about the Bio Control system, Process regulation.
- To understand the concept behind feedback and continuum in various systems and subsystems.
- To apply mathematical modelling principles in understanding the various fundamental biological systems
- To study system concept of biological control

INTENDED OUTCOME:

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

- Understand the need for mathematical modelling of various systems,
- Understand the representation of systems in block diagrams and signal flow graphs
- Analyze the process regulation
- Understand the concept of modelling basic physiological systems
- Understand the concept of oxygen and carbon dioxide transport in blood
- Explain the concept of Endocrine control system

UNIT I INTRODUCTION TO BIO CONTROL SYSTEM

Introduction: Technological control system, transfer function, mathematical approaches, system stability, introduction to biological control system, Modelling and block diagram, closed loop dynamics of first order and second order control system, similarities between biological and engineering control system, biological receptors and receptor characteristics.

UNIT II PROCESS REGULATION

Acid-base balance, extra-cellular water and electrolyte, interstitial fluid volume, blood pressure, blood glucose, CO2.

UNIT III MODELING OF HUMAN THERMAL REGULATORY SYSTEM

Parameters involved, control system model etc. Biochemistry of digestion, types of heat loss from body, models of heat transfer between subsystems of human body like skin - core etc. and systems like within body, body environment.

UNIT IV BIOLOGICAL CONTROL I

Cardiac rate, blood pressure, respiratory rate, mass balancing of lungs, oxygen uptake by RBC and pulmonary capillaries, oxygen and carbon dioxide transport in blood and tissues.

UNIT V BIOLOGICAL CONTROL II

Urine formation and control, Pupil control systems, skeletal muscle servomechanism and semicircular canal. Free swinging limbs, Endocrine control system.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sujit K.Chaudhuri	Concise Medical Physilogy	New Central Book agency	1997
2	Ogata Katsuhika	Modern control engineering	2nd edition, Prentice Hall of	-

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Barry R. Dworkin	Learning and Physiological Regulation (Hardcover)	University Of Chicago Press	March 1993
2	E. Carson, E. Salzsieder	Modelling and Control in Biomedical Systems 2000 (including Biological Systems)	Pergamon Publishing	January 2001

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME502 BIOMEDICAL INSTRUMENTATION 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students:

- To illustrate origin of bio potentials and its propagations
- To understand the basic theory of Bio potential Electrodes and Bio potential measurement.
- To appraise the different types of electrodes and its placement for various recordings
- To design bio amplifier for various physiological recordings
- To study the various bio chemical measurements.
- To perceive the different measurement techniques for non-physiological parameters.

INTENDED OUTCOMES:

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

- Differentiate different bio potentials and its propagations.

- Describe the electrode behaviour and circuit models
- Illustrate different electrode placement for various physiological recordings
- Design bio amplifier for various physiological recordings
- Explain various technique for non-electrical physiological measurements
- Measure various biochemical parameters.

UNIT I BIO POTENTIAL ELECTRODES

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.

UNIT II ELECTRODE CONFIGURATIONS

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode .EMG, ERG and EOG – unipolar and bipolar mode.

UNIT III BIO AMPLIFIER

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier.

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETER

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V BIO-CHEMICAL MEASUREMENT

Biochemical sensors - pH, pO2 and pCo2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Joseph J. Carr and John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education	2004
2	John G. Webster	Medical Instrumentation Application and Design	John Wiley and sons	2004

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Leslie Cromwell	Biomedical Instrumentation and	Prentice hall of India, New Delhi	2007
2	Khandpur R.S	Handbook of Biomedical Instrumentation	Tata McGraw-Hill, New Delhi	2003
3	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw-Hill	2003

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME503 BIOMEDICAL SIGNAL PROCESSING 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students:

- To study the characteristics of different bio signals.
- To learn linear and non-linear filtering techniques to extract desired information
- To analyse the characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG, and EMG.
- To perceive choice of filters to remove noise and artefacts from biomedical signals.
- To apply established engineering methods to analyse ECG signal problems.
- To discuss established engineering methods to analyse neurological signals.

INTENDED OUTCOMES:

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

- Design different types of biomedical signals and identify their spectral components.
- Utilize different filters on biomedical signals and judge filter performance.
- Identify physiological interferences and artifacts affecting ECG signal.
- Assess power and correlation spectra of EEG signal.
- Analyze biosignals in time and frequency domains.
- Perform classification and recognition Biosignals

UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS

Sampling of Analogue signals – aliasing – standard discrete time signals – classification – discrete time systems – Linear time invariant stable casual discrete time systems – classification methods – linear and circular convolution – difference equation representation – DFS, DTFT, DFT – FFT computations using DIT and DIF algorithms.

UNIT II INFINITE IMPULSE RESPONSE DIGITAL FILTERS

Review of design of analogue Butterworth and Chebyshev Filters, Frequency transformation in analogue domain – Design of IIR digital filters using impulse invariance technique – Design of digital filters using bilinear transform – Realization using direct, cascade and parallel forms.

UNIT III FINITE IMPULSE RESPONSE DIGITAL FILTERS

Symmetric and Asymmetric FIR filters – Linear phase FIR filters – Design using Frequency sampling technique – Window design using Hamming, Hanning and Blackmann Windows – Realisation of FIR filters

UNIT IV ANALYSIS OF BIO –SIGNALS

Removal of artifacts-ECG, Event detection –ECG,P wave, QRS Complex, T wave, correlation analysis of ECG signals, Averaging of signals-PCG, ECG and EMG.

UNIT V PROCESSING OF BIO SIGNALS

Heart rate variability Analysis, Analysis of PCG signals, Analysis of Time variant systems, Fixed segmentation –STFT, ACF, SEM and GLR.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication

1	John G. Proakis and Dimitris G.Manolakis	Digital Signal Processing, Algorithms and Applications	PHI of India Ltd., New Delhi, 3rd Edition	2000
2	Rangaraj.M.Rangayyan	Biomedical signal processing	-	-

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sanjit K.Mitra	Digital Signal Processing', A Computer Based Approach	Tata McGraw-Hill, New Delhi	1998

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BECC504 PROFESSIONAL ETHICS 3 0 0 3 100

PRINCIPLES OF MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

OBJECTIVE:

The goal of this course is for students:

- To develop managerial and entrepreneurial skills our culture and ethics
- To Distinguish Direct and Preventive Control
- To perceive Knowledge on the principles of management is essential for all kinds of people in all kinds of organisations
- To have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling
- To create an awareness and practice through engineering ethics and human values

- To outline how business ethics works

INTENDED OUTCOMES:

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

- Advanced philosophical knowledge of the profession of recreation and leisure
- Synthesis of trends and issues as related to current professional practice
- Evaluate organizational theories and human resource management principles
- Analyse the information competency
- Follow Ethical practice and ethical management
- Understand Models of Professional Roles

UNIT I ENGINEERING ETHICS

Senses of 'Engineering Ethics' – variety of moral issued – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self–interest – customs and religion – uses of ethical theories.

UNIT II FACTORS OF CHANGES

Forces that shape culture, social control – Meaning, Agencies, Institution, Customs, Values, Folkways, Norms and Laws.Social changes – Meaning and nature – Theories.

UNIT III HISTORICAL DEVELOPMENT, PLANNING, ORGANISING

Definition of Management – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies and Planning Premises– Forecasting – Decision–making – Formal and informal organization – Organization Chart –.

UNIT IV DIRECTING AND CONTROLLING

Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment –Process of Communication – System and process of Controlling – Requirements for effective control – Control of Overall Performance – Direct and Preventive Control – Reporting

UNIT V ENTREPRENEURSHIP AND MOTIVATION

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth– Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

TEXT BOOKS:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Harold Kooritz and Heinz Weihrich	Essentials of Management	Tata McGraw Hill, New Delhi	2010

2	Khanka S.S	Entrepreneurial Development	S.Chand and Co. Ltd., NewDelhi	2006
3	Mike Martin and Roland Schinzinger	Ethics in Engineering	McGraw–Hill, NewYork	2005

REFERENCES:

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Tripathy P.C and Reddy P.N	Principles of Management	Tata McGraw Hill, New Delhi	2008
2	Rabindra N Kanungo	Entrepreneurship and innovation	Sage Publications, New Delhi	1998
3	Charles E Harris, and Michael J Rabins	Engineering Ethics – Concepts and Cases	Wadsworth Thompson Learning, New Delhi	2013

WEB REFERENCES

1. http://www.managementstudyguide.com/taylor_fayol.htm
2. http://tutor2u.net/business/gcse/people_motivation_theories.htm
3. http://lfkkb.tripod.com/eng24/gilliganstheory.html
4. http://www.developingeyes.com/five–types–of–entrepreneurs/

19BEBME5E-- Professional Elective I 3 0 0 3 100

19BEBME5E-- Professional Elective II 3 0 0 3 100

19BEBME511 BIOMEDICAL INSTRUMENTATION & SIGNAL PROCESSING LAB 0 0 3 2 100

COURSE OBJECTIVES:

The goal of this course is for students:

- To discuss the working principle of Biomedical Instrumentation systems.
- To infer the basic acquisition techniques of bioelectric signals.
- To learn about Audiometer
- To understand the concept of Signal Averaging
- To analyse ECG signal
- To experiment with basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Create coding for different convolution and correlation techniques.
- Develop preamplifiers and amplifiers for various bio signal recordings.
- Measure various non-electrical parameters using suitable sensors/transducers
- Perform biosignal Acquisition
- Analyse ECG signal
- Understand about SNR improvement

Laboratory Experiments:

1. Acquisition and recording of Electrocardiogram.
2. Acquisition of Electromyogram and determining conduction velocity.
3. Study of Audiometer and Air conduction thresholds testing; Plotting of Audiogram.
4. Study of Blood Pressure meter and Phonocardiograph.
5. Design and implementation of circuits with biomedical applications (like QRS detector, ECG Amplifier, EMG …..etc)
6. Study and acquisition of PPG signals.
7. Spectral Modeling and Analysis of ECG Signals
8. Detection of QRS complex and heart rate measurement.
9. Auto-correlation and cross correlation of ECG signals.
10. Signal Averaging to improve the SNR.
11. Design of 50 Hz notch filter for ECG signal and display PSD.

19BEBME512	**Course Oriented project-III**	**0 0 3 2**	**100**

19BECC551	**FUNDAMENTALS OF MARKETING FOR BIO-MEDICAL ENTREPRENEURS**	**1 0 0**	**100**

OBJECTIVE

- To equip the students with requisite knowledge and skills
- To equip the students with right attitude necessary to provide effective leadership in a global environment.
- To develop competent management professionals with strong ethical values,
- To develop the students with capable of assuming a pivotal role in various sectors of the Indian Economy &Society, aligned with the national priorities.
- To develop proactive thinking so as to perform effectively in the dynamic socio-economic and business ecosystem.
- To harness entrepreneurial approach and skillsets.

OUT COME

- Competent managers with requisite knowledge, skills and right attitude
- Sustenance in globally competitive environment.
- Management professionals with pro-active thinking and Innovative approach
- Sensitive professionals with ethical values.
- Leaders with concern towards Nation and society at large
- Entrepreneurial approach and skillsets to contribute for socio-economic development

Basic table mannerism – common sense – public behaviour – attitude – genuinity & Uniqueness – roles and functions of marketing executives - Voice modulation - tone and phonetics – Market Analysis – telemarketing – E & Online Marketing – customer support and handling

SEMESTER VI

19BEBME601 BIOMEDICAL IMAGE PROCESSING 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students:

- To study the formation of an image and its acquisition
- To introduce the use and application of transforms in image processing
- To explain the fundamentals of medical image acquisition, processing and storage.
- To discuss simple image enhancement techniques in Spatial and Frequency domain.
- To appraise the concepts of degradation function and restoration techniques.
- To apply image compression and recognition methods.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the image fundamentals and mathematical transforms necessary for image processing.
- Illustrate the image enhancement techniques.
- Preprocess the image using filtering techniques
- Utilize image restoration procedures.
- Segment the region of interest in images.
- Apply the image compression procedures.

UNIT I DIGITAL IMAGE FUNDAMENTAL

Elements of digital image processing systems, Elements of Visual perception, Image sampling and quantization, – Some Basic relationships between pixels, Matrix and Singular Value representation of discrete images.

UNIT II IMAGE TRANSFORMS

2D DFT, Cosine, Sine Hadamard, Haar, Slant, KL transform and their properties.

UNIT III IMAGE ENHANCEMENT

Histogram – Modification and specification techniques, Enhancement by point processing Image smoothening, Image sharpening, generation of spatial masks from frequency domain specification, Homomorphic filtering, and color image processing.

UNIT IV IMAGE RESTORATIONAND RECONSTRUCTION OF MEDICAL IMAGE

Image degradation models, Unconstrained and Constrained restoration, inverse filtering, Least mean square filter, Image reconstruction from projections – Radon transforms, Filter back projection algorithm, Fourier reconstruction of MRI Images.

UNIT V MEDICAL IMAGE COMPRESSION TECHNIQUES

Run length, Huffman coding, arithmetic coding, Pixel coding, transform coding, JPEG Standard, predictive techniques, Application of image processing techniques in thermography, SPECT, PET images.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Rafael C., Gonzalez and Richard E. Woods	Digital Image Processing	Pearson Education Asia	2001

2	Anil K. Jain	Fundamentals of Digital Image Processing	Prentice Hall of India	1997

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	William K. Pratt	Digital Image Processing	John Wiley	1987

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME602 BIOMECHANICS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students:

- To perceive about the principles of biomechanics.
- To study about the mechanics involved with various physiological systems.
- To gain knowledge about musculoskeletal mechanics
- To infer the mechanics of physiological systems.
- To discuss the mechanics of joints.

- To create mathematical models used in the analysis of biomechanical systems

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the principles of biomechanics.
- Discuss the mechanics of physiological systems.
- Demonstrate the mechanics of joints.
- Analyze the biomechanical systems using mathematical models.
- Design and develop the models specific to orthopedic applications
- Illustrate the mathematical models used in the analysis of biomechanical systems.

UNIT I INTRODUCTION TO MECHANICS

Introduction – Scalars and vectors, Statics – Force types, Resolution and composition of forces, Moments of force and couple, Resultant force determination, parallel forces in space, equilibrium coplanar forces, Dynamics, Basic principles – Linear motion, Newton‘s laws of motion, Impulse and Momentum, Work and Energy Kinetics – Velocity and acceleration, Kinematics – Link segment models, Force transducers, Force plates, Introduction to Constitutive equations – Constitutive equations of Non viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid

UNIT II BIOFLUID MECHANICS

Intrinsic fluid properties – Density, Viscosity, Compressibility and Surface Tension, Viscometers – Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube – Steady Laminar flow, Turbulent flow, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation, Structure of blood vessels, Material properties and modeling of Blood vessels, Heart –Cardiac muscle characterization, Native heart valves – Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

UNIT III BIOSOLID MECHANICS

Constitutive equation of viscoelasticity – Maxwell &Voight models, anisotropy, Hard Tissues – Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modeling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle – Muscle action, Hill‘s models, mathematical modeling, Bone fracture mechanics, Implants for bone fractures.

UNIT IV BIOMECHANICS OF JOINTS

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder,

spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

UNIT V MODELING AND ERGONOMICS

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics – Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Y.C. Fung	Bio-Mechanics- Mechanical Properties of Tissues ‖	Springer-Verlag	1998
2	Subrata Pal	Textbook of Biomechanics ‖	Viva Books Private Limited	2009

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers	Biofluid Mechanics: The Human Circulation ‖	Taylor and Francis	2007
2	Sheraz S. Malik and Shahbaz S. Malik	Orthopaedic Biomechanics Made Easy‖	Cambridge University Press	2015
3	Jay D. Humphrey, Sherry De Lange	An Introduction to Biomechanics: Solids and Fluids, Analysis and Design‖	Springer Science Business Media	2004
4	Shrawan Kumar	Biomechanics in Ergonomics‖, Second Edition	CRC Press	2007
5	Neil J. Mansfeild	Human Response to Vibration‖,	CRC Press	2005
6	Carl J. Payton	Biomechanical Evaluation of movement in sports and Exercise‖	-	2008

19BEBME603 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – I&II 3003 100

OBJECTIVES:

The goal of this course is for students:

- To perceive the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.
- To analyze some of the cardiac assist devices.
- To understand the principle of diathermy
- To discuss about the measurement of the signals generated by muscles.
- To summarize the need and use of some of the extracorporeal devices.

- To learn the patient safety measures

OUTCOMES:

Upon completion of this course, students will be able to:

- Utilize different medical devices applied in measurement of parameters related to cardiology, neurology
- Explain about cardiac assist devices, its continuous monitoring and transmission
- Measure signals generated by muscles
- Analyze different types of diathermy units.
- Identify the electrical hazards and Implement methods of patient safety
- Interpret the need and use of the extracorporeal devices.

UNIT I CARDIAC EQUIPMENT

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, Plethysmography. Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External

UNIT II NEUROLOGICAL EQUIPMENT

Clinical significance of EEG, Multi channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation.

UNIT III SKELETAL MUSCULAR EQUIPMENT

Generation of EMG, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

UNIT IV PATIENT MONITOING AND BIOTELEMETRY

Patient monitoring systems, ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

UNIT V SPECIAL DIAGNOSTIC TECHNIQUES

Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laproscopy.Thermography – Recording and clinical application, ophthalmic instruments.

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Khandpur R.S	Handbook of Biomedical Instrumentation	Tata McGraw Hill	2003

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	Mc Graw Hill	2003
2	L.A Geddes and L.E.Baker	Principles of Applied Biomedical Instrumentation	Mc Graw Hill	2008
3	Leslie Cromwell	Biomedical Instrumentation and Measurement	Pearson Education, New	2007
4	Antony Y.K.Chan	Biomedical Device Technology, Principles and design	Charles ThomasPublisher Ltd	2008
5	Joseph J. Carr and John M. Brown	Introduction to Biomedical Equipment Technology	Pearson education	2004
6	John G.Webster	Medical Instrumentation Application and Design	John Wileyand Sons	2006

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME604 HEALTHCARE & HOSPITAL MANAGEMENT 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students:

- To discuss the fundamentals of hospital administration.
- To learn about Bio-Medical Waste Management.
- To analyze the market related research process.
- To summarize the quality and safety aspects in hospital.
- To perceive knowledge about human resource management in hospital
- To explain about hospital information systems

INTENDED OUTCOMES:

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

- Explain various information management systems and relative supportive services.
- Interpret market related research processes in healthcare and hospital sectors.
- Illustrate the quality and safety aspects in hospital.
- Demonstrate about human resource management in hospital
- Understand about NABH and NABL
- Explain the importance of supportive services

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management.

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPITAL

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III MARKETING RESEARCH PROCESS

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	R.C.Goyal,	Hospital Administration and Human Resource Management‖	PHI – Fourth Edition	2006
2	G.D.Kunders	Hospitals – Facilities Planning and Management – TMH, New Delhi	Fifth Reprint	2007

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Cesar A.Caceres and Albert Zara	The Practice of Clinical Engineering	Academic Press, New York	1977
2	Norman Metzger	Handbook of Health Care Human Resources Management‖	2nd edition Aspen Publication Inc. Rockville, Maryland, USA	1990
3	Peter Berman	Health Sector Reform in Developing Countries‖	Harvard University Press	1995
4	William A. Reinke	Health Planning For Effective Management‖	Oxford University Press	1988
5	Blane, David, Brunner	Health and SOCIAL Organization: Towards a Health Policy for the 21st Century‖	Eric Calrendon Press	2002
6	Arnold D. Kalcizony & Stephen M. Shortell	Health Care Management‖	6th Edition Cengage Learning	2011

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME6E--	**Professional Elective III**	**3 0 0 3**	**100**
19BEBME6E--	**Professional Elective IV**	**3 0 0 3**	**100**

19BEBME611 BIO-MEDICAL IMAGE PROCESSING LAB 0 0 3 2 100

OBJECTIVE:

The goal of this course is for students to:

- To implement fundamental image processing techniques in Biomedical Images.
- To infer enhancement and Transformation of Medical Images.
- To perceive knowledge about reconstruction of images.
- To learn about pre processing of image

- To understand the CT images
- To study the MATLAB implementation

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the image fundamentals and mathematical transforms necessary for image processing.
- Illustrate the image enhancement techniques.
- Pre process the image using filtering techniques
- Utilize image restoration procedures.
- Segment the region of interest in images.
- Apply the image compression procedures.

LIST OF EXPERIMENTS:

1. Digital image Fundamentals.
2. Image Enhancement and Transformation.
3. Edge detection and boundary tracing techniques.
4. Removal of noise in medical images.
5. Image compressions.
6. Restoration of CT images.
7. Reconstruction of images.
8. Image Analysis.
9. MATLAB implementation.

19BEBME612 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY 0 0 3 2 100

OBJECTIVES:

The goal of this course is for students:

- To learn about Electrical safety measurements
- To understand the concept the ultrasonic diathermy
- To understand the concept of biotelemetry

- To provide practice on recording and analysis of different Bio potentials
- To learn different non-electrical parameters using various methods.
- To study the function of different Therapeutic equipment.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Measure different bioelectrical signals using various methods
- Assess different non-electrical parameters using various methodologies
- Illustrate various diagnostic and therapeutic techniques.
- Handle therapeutic equipment
- Design ECG amplifier
- Design and simulate by using Lab View

LIST OF EXPERIMENTS:

1. Simulation of ECG – detection of QRS complex and heart rate
2. Study of shortwave and ultrasonic diathermy
3. Study of biotelemetry
4. Electrical safety measurements.
5. Measurement of Respiratory parameters using spirometry.
6. Study of medical stimulator.
7. Study of ESU – cutting and coagulation modes
8. Recording of Audiogram
9. Design of ECG amplifier, recording and analysis using Lab View

19BEBME651	**Mini Project**	**0 0 1 -**	**100**

19BEBME652 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C 3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To understand Data, expressions and statements
- To learn about Python functions
- To know about files and dictionaries

INTENDED OUTCOMES:

- Explain various operators used in python.
- Elaborate Object oriented concepts with python
- Demonstrate the functions of networking in python
- Develop algorithmic solutions to simple computational problems.
- Read and write data from/to files in Python programs.
- Utilize image processing techniques in python programming to solve a given problem

UNIT I ALGORITHMIC PROBLEM SOLVING

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters;Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Allen B. Downey	Think Python: How to Think Like a Computer Scientist	Shroff/O'Reilly Publishers	2016
2	Guido van Rossum and Fred L. Drake Jr	An Introduction to Python – Revised and updated for Python 3.2	Network Theory Ltd	2011

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	John V Guttag	Introduction to Computation and Programming Using Python	MIT Press	2013
2	Robert Sedgewick, Kevin Wayne, Robert Dondero	Introduction to Programming in Python- An Inter-disciplinary Approach	Pearson India Education Services Pvt. Ltd	2016
3	Timothy A. Budd	Exploring Python	Mc-Graw Hill Education (India)	2015
4	Kenneth A. Lambert	Fundamentals of Python: First Programs‖	CENGAGE Learning	2012
5	Charles Dierbach	Introduction to Computer Science using Python: A	Wiley India Edition	2013.
6	Paul Gries, Jennifer Campbell and Jason	Practical Programming: An Introduction to Computer	Pragmatic Programmers, LLC	2013

SEMESTER VII

19BEBME701 VIRTUAL BIOINSTRUMENTATION 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students:

- To introduce virtual instrumentation concepts and applications.
- To discuss about programming structure in LabVIEW.
- To analyze data acquisition hardware.
- To infer knowledge on VI programs for specific applications.
- To perceive the basics of virtual instrumentation.
- To program virtual instrumentation software for biomedical applications.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Illustrate programming concepts of virtual instruments.
- Compile programming structure in LabVIEW.
- Understand the use of VI for data acquisition.
- analyze different types of interfaces.
- Choose data from hardware systems.
- Develop VI programs for specific applications.

UNIT I REVIEW OF VIRTUAL INSTRUMENTATION

Historical perspectives, Need of VI, advantages, Define VI, block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Graphical programming in data flow, comparison with conventional programming.

UNIT III DATA ACQUISITION BASICS

ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation. GPIB/IEEE 488 concepts, and embedded system buses - PCI, EISA, CPCI, and USB & VXI. A

UNIT IV COMMON INSTRUMENT INTERFACES

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and lVI, image acquisition and processing. Motion control. ADC, DAC, DIO, DMM, waveform generator.

UNIT V USE OF ANALYSIS TOOLS

Fourier transforms, power spectrum correlation methods, windowing & filtering, Major equipments- Oscilloscope, Digital Multimeter, Pentium Computers, Application in Biomedical field

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Gary Jonson	Labview Graphical Programming	Second Edition, McGraw Hill, NewYork	1997
2	Lisa K.wells & Jeffrey Travis	Labview for everyone	, Prentice Hall Inc., New Jersey	1997

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sokol off	Basic concepts of Labview 4	Prentice Hall Inc., New Jersey	1998
2	S.Gupta, J.P: Gupta	PC interfacing for Data Acquisition & Process Control	Instrument Society of America	1994
3	L.T.Amy	Automation System for Control and Data Acquisition	ISA	1992

19BEBME702 REHABILITATION ENGINEERING 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students:

- To perceive the rehabilitation concepts and Rehabilitation team for future development and applications.
- To understand the Primary & secondary Disabilities
- To discuss various Principles of Rehabilitation Engineering.
- To infer the various orthotic devices and prosthetic devices to overcome orthopedic problems.
- To explain the need for medical aids.

- .To explain about different types of models of Hand and arm replacement

INTENDED OTCOMES:

UNIT I INTRODUCTION TO REHABILITATION

What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team Classification of members, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.

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

- Elaborate about the needs of rehabilitations and its future development.
- Understand the terminologies used by the rehabilitation team
- Demonstrate Engineering Concepts in Sensory & Motor rehabilitation. Apply the different types of Therapeutic Exercise Technique to benefit the society.
- Design and apply different types Hearing aids, visual aids and their application in biomedical field and hence the benefit of the society.
- Understand the need of virtual reality based rehabilitation
- Simplify about different types of models of Hand and arm replacement.

UNIT II PRINCIPLES OF REHABILITATION

Introduction, The Human Component, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles - Practice of Rehabilitation and Assistive Technology.

UNIT III THERAPEUTIC EXERCISE TECHNIQUE

Co-ordination exercises, Frenkels exercises, Gait analyses-Pathological Gaits, Gait Training, Relaxation exercises-Methods for training Relaxation, Strengthening exercises-Strength training, Types of Contraction, Mobilisation exercises, Endurance exercises.

UNIT IV MANAGEMENT OF COMMUNICATION & VIRTUAL REALITY

Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids. Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES

General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO. Prosthetic devices: Hand and arm replacement, Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and Walking, Hybrid Assistive Systems (HAS).

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Sunder	Textbook of Rehabilitation	Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi 2nd Edition	2007
2	Joseph D.Bronzino	The Biomedical Engineering Handbook	Third edition-3 volume set, Taylor & Francis	2006

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Horia- Nocholai Teodorecu, L.C.Jain	Intelligent systems and technologies in rehabilitation Engineering	CRC Press / IEEE Press	2000
2	Keswick. J	What is Rehabilitation Engineering, Annual Reviews of Rehabilitation	SpringerVerlag	1982
3	Warren E. Finn, Peter G. Lo Presti	Handbook of Neuroprosthetic Methods	Plenum press, New York	2002
4	Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor)	An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering	CRC Press	2006

WEBSITES:

1. www.mit.edu
2. www.nptel.com

17	**____OE__**	**OPEN ELECTIVE - 1**	**0 0 3 3**	**100**
17	**____OE__**	**OPEN ELECTIVE - 2**	**0 0 3 3**	**100**
19BEBME7E--		**PROFESSIONAL ELECTIVE V**	**3 0 0 3**	**100**

19BEBME711	**VIRTUAL BIOINSTRUMENTATION LAB**	**0 0 3 2**	**100**

OBJECTIVE:

The goal of this course is for students:

- To perceive the basics of virtual instrumentation
- To familiarize the students with Virtual Instrumentation and to do programming for applications
- To understand the D/A acquisition interface
- To analyse timing issues

- To learn about GPIB
- To do program with Lab view software for biomedical applications

INTENDED OUTCOMES:

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

- understand about Programming Techniques
- learn about Data Acquisition and inter facing techniques
- do programming for process control and other applications
- use D/A acquisition interface
- use serial communication interface
- use Lab view software for biomedical signal analysis

LIST OF EXPERIMENTS:

1. Getting Started with Lab VIEW – Basic operations, controls and indicators.
2. Simple programming structures and Timing Issues
3. Lab VIEW – Debugging a VI, Sub-VI's
4. Lab VIEW – Traffic Light - Programming Structure, Sub-Vis, Clusters
5. GPIB-Serial poll Byte
6. Communication via RS232/ Serial Port.
7. Oscilloscope - Attribute Nodes, Menus
8. RC Circuit measurement - Timing issues
9. Lab VIEW – Incorporating user written C subroutines
10. Digital-to-Analog acquisition interfacing - Analog I/O
11. The RS232 Interface – Function Generator
12. Importing pictures, Global/ local variables. Arrays, Clusters

19BEBME712	**Hospital Training**	**0 0 3 2**	**100**
19BEBME791	**Project Work Phase I**	**0 0 8 4**	**100**

SEMESTER VIII

19BEBME801	**ARTIFICIAL ORGANS AND IMPLANTS**	**3 0 0 3**	**100**

OBJECTIVES:

The goal of this course is for students:

- To discuss the overview of artificial organs & transplants
- To extend the principles of implant design with a case study
- To explain the implant design parameters and solution in use
- To simplify about various blood interfacing implants
- To know the biocompatibility of artificial organs
- To learn about the implantable medical devices

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the implant design parameters and solution in use
- Analyze about various blood interfacing implants
- Evaluate response of biomaterials in living system
- Perceive knowledge about artificial organs & transplants
- Demonstrate different types of soft tissue replacement and hard tissue replacement
- Assess biocompatibility of artificial organs

UNIT I ARTIFICIAL ORGANS & TRANSPLANTS

ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT II PRINCIPLES OF IMPLANT DESIGN

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kopff W.J	Artificial Organs	John Wiley and sons, New York, 1st edition	1976
2	Park J.B.,	Biomaterials Science and Engineering‖	Plenum Press	1984

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	J D Bronzino	Biomedical Engineering handbook Volume II	CRC Press / IEEE Press	2000
2	R S Khandpur	Handbook of Biomedical Instrumentation	Tata McGraw Hill	2003
3	Joon B Park	Biomaterials – An Introduction	Plenum press, New York	1992
4	Yannas, I. V	Tissue and Organ Regeneration in Adults‖	New York, NY: Springer	2001
5	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino	Clinical Engineering‖	CRC Press, 1st edition	2010
6	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw- Hill	2003

19BEBME8E--	**PROFESSIONAL ELECTIVE VI**	**3 0 0 3**	**100**
19BEBME8E--	**PROFESSIONAL ELECTIVE VII**	**3 0 0 3**	**100**

19BEBME891	**PROJECT WORK PHASE II AND VIVAVOCE**	**0 0 32 16**	**100**

FOR SEMESTER V (ELECTIVE-I & II)

19BEBME5E01	**ERGONOMICS**	**3 0 0 3**	**100**

OBJECTIVES:

The goal of this course is for students:

- To be exposed to principles of ergonomics.
- To develop the mechanics of muscle physiology concepts.
- To understand the anthropometric design principles
- To learn the process of hearing
- To infer the factors in design of work space surfaces
- To familiar with the mathematical models, analysis and design of biomedical devices using case studies.

INTENDED OUTCOMES:

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

- Understand principles of ergonomics.
- Analyse the factors in design of work space surfaces
- Elaborate with the mathematical models, analysis and design of biomedical devices using case studies.
- Apply the principles of good ergonomic design in anthropometry
- Design biomedical devices by applying ergonomics.
- Optimize the design of Medical Equipment.

UNIT I VISUAL AND AUDITORY ERGONOMICS

Process of seeing – visual capabilities-factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display-process of hearing-principles of auditory display.

UNIT II MUSCLE PHYSIOLOGY

Muscle physiology -muscle metabolism-respiratory response-joint motion study- measure of physiological in-efficiency and energy consumption-work rest cycles-aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH.

UNIT III CONTROLS AND DISPLAYS

Spatial compatibility physical arrangement of displays and controls- movement capability- rotary controls and rotar displays movement of displays orientation of the operator and movement relationships control orders and control responses- human limitations in tracking task.

UNIT IV ANTHROPOMETRY

Anthropometry- anthropometric design principles –work space envelope- factors in design of work space surfaces- principles of seat design –principles of control panel. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

UNIT V CASE STUDIES

Case Study 1: computer design, control panel design of an electronic instrument, computer key board, hand drill etc. Case Study 2: Biomedical Application, Design optimization of Medical Equipments.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Pascale Carayon	Handbook of Human Factors and Engineering, Second Edition	CRC Press	2011
2	Robert.N. Bailey	Human Performance Engineering, Third Edition	-	1996
3	Martin Helander	Guide to Human Factors and Ergonomics, Second Edition	CRC Press	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Shrawan Kumar	Biomechanics in Ergonomics, Second Edition	CRC Press	2007
2	Stephen Pheasant, Christine M. Haslegrave	Body space: Anthropometry, Ergonomics and the Design of Work	CRC Press	2016

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME5E02 BIOMETRIC SYSTEMS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students:

- To introduce the relevance of this course to the existing technology
- To infer the technologies of finger print,iris,face and speech recognition.
- To develop the general principles of design of biometric systems and the underlying trade-offs.
- To recognize personal privacy and security implications of biometrics-based identification technology.
- To identify issues in the realistic evaluation of biometrics-based systems.
- To explain biometric authentication

INTENDED OUTCOMES:

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

- Demonstrate the technologies of finger print, iris, face and speech recognition
- Analyse the general principles of design of biometric systems and the underlying trade-offs.
- Identify personal privacy and security implications of biometrics-based identification technology.
- Develop fingerprint recognition technique.
- Analyse Feature Extraction and Pattern Classification
- Perceive the issues in the realistic evaluation of biometrics-based systems.

UNIT I INTRODUCTION TO BIOMETRICS

Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrolment – templates – algorithm – verification – Biometric applications – biometric characteristics- Authentication technologies –Need for strong authentication - Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics

UNIT II FINGERPRINT TECHNOLOGY

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm – Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy – training and adaptability – examples of multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. -. Expectation- Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	James Wayman, Anil Jain, Davide Maltoni	Biometric Systems, Technology Design and Performance Evaluation	Springer	2005
2	S.Y. Kung, S.H. Lin, M.W.Mak	Biometric Authentication: A Machine Learning Approach	Prentice Hall	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Paul Reid	Biometrics for Network Security	Pearson Education	2004
2	Nalini K Ratha, Ruud Bolle	Automatic fingerprint Recognition System	Springer	2003
3	L C Jain, I Hayashi, S B Lee, U Halici	Intelligent Biometric Techniques in Fingerprint and	CRC Press	1999
4	John Chirillo, Scott Blaul	Implementing Biometric Security	John Wiley	2003
5	Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain	Handbook of Multibiometrics	Springer	2006

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME5E03 MEDICAL OPTICS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To Understand Biomedical Laser principles and applications.
- To be familiar with optical properties of tissues
- To infer the knowledge of photonics
- To be exposed to Optical Holography
- To explain the various applications of Laser
- To understand photodynamic therapy.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Analyse the optical properties of tissues
- Use the Photonics instrumentation
- Apply lasers in different areas of medicine.
- Perceive the lasers in ophthalmology
- Discuss about optical hologram
- Explain the special techniques of Lasers.

UNIT I OPTICAL PROPERTIES OF THE TISSUES

Fundamental Properties of light - Refraction, Reflection, Laws (Snell's law and Fresnel law) Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology, Laser tissue Interactions – Photo chemical, Photo thermal and Photo mechanical interactions, Fluorescence, Speckles, Photo ablative processes.

UNIT II INSTRUMENTATION IN PHOTONICS

Instrumentation for absorption, Scattering and emission measurements, Excitation light sources – high pressure arc lamps, LEDs, Lasers, Optical filters – Prism and Monochromators, Polarizers, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection methods, Optical fibers – Total Internal Reflection.

UNIT III SURGICAL THERAPEUTIC APPLICATIONS OF LASERS

Lasers in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.

UNIT IV NON THERMAL DIAGNOSTIC APPLICATIONS

Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and Speckle applications of lasers in biology and medicine.

UNIT V DIAGNOSTIC AND THERAPEUTIC TECHNIQUES

Near field imaging of biological structures, In vitro clinical diagnostics, Phototherapy, Photodynamic therapy (PDT) - Principles and mechanisms - Oncological and non-oncological applications of PDT – Bio stimulation effect – applications - Laser Safety Procedures.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tuan Vo Dirh	Biomedical Photonics - Handbook‖	CRC Press, Bocaraton	2014

2	Paras N. Prasad	Introduction to Bio photonics‖	A. John Wiley and Sons, Inc. Publications	2003

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Markolf H.Niemz	Laser-Tissue Interaction Fundamentals and Applications‖	Springer	2007
2	G.David Baxter	Therapeutic Lasers – Theory and practice‖,	Churchill Livingstone publications Edition	2001
3	Leon Goldman, M.D., & R.James Rockwell, Jr	Lasers in Medicine‖	Gordon and Breach, Science Publishers Inc	1975

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME5E04 BIOMATERIALS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To infer characteristics and classification of Biomaterials.
- To understand the response of biomaterials in living system
- To identify different metals, ceramics and its nanomaterial‘s characteristics as Biomaterials.
- To interpret polymeric materials and its combinations that could be used as a tissue replacement implants.
- To discuss the concepts of Nano Science and Technology.
- To perceive the concept of biocompatibility and the methods for biomaterials testing.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
- Evaluate response of biomaterials in living system.
- Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
- Determine significant gap required to overcome challenges and further development in polymeric materials
- Create combinations of materials that could be used as a tissue replacement implant.
- Perceive the testing standards applied for biomaterials.

UNIT I INTRODUCTION TO BIO-MATERIALS

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.

UNIT II METALLIC AND CERAMIC MATERIALS

Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.

UNIT III POLYMERIC IMPLANT MATERIALS

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.

UNIT IV TISSUE REPLACEMENT IMPLANTS

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Softtissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

UNIT V TESTING OF BIOMATERIALS:

Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication

1	. Sujata V. Bhatt	Biomaterials‖, Second Edition	Narosa Publishing House	2005
2	Sreeram Ramakrishna, Murugan Ramalingam, T. S. Sampath Kumar, and Winston O.Soboyejo	Biomaterials: A Nano Approach‖	CRC Press	2010

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Myer Kutz	Standard Handbook of Biomedical Engineering & Design‖	McGraw Hill	2003
2	John Enderle, Joseph D. Bronzino, Susan	Introduction to Biomedical Engineering‖	Elsevier	2005
3	Park J.B	Biomaterials Science and Engineering‖	Plenum Press	1984
4	C Anand, J F Kennedy, M.Miraftab	Woodhead Medical Textiles and Biomaterials for Healthcare II	Publishing Limited	2006
5	D F Williams	Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive	VCH Publishers	1992
6	Monika Saini, Yashpal Singh, Pooja Arora, Vipin	Implant biomaterials: A comprehensive review‖	World Journal of Clinical	2015

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME5E05 INTERNET OF THINGS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students:

- To understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols.
- To discuss about design and development of IoT systems.
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

INTENDED OUTCOME :

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

- Explain the concept of IoT.
- Analyse various protocols for IoT.
- Build simple IoT Systems using Arduino and Raspberry Pi.
- Apply data analytics and use cloud offerings related to IoT.
- Analyse applications of IoT in real time scenario.
- Utilize concepts of design and development of IoT systems.

UNIT I FUNDAMENTALS OF IoT

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMENT

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TEXTBOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things	Cisco Press	2017

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Arshdeep Bahga, Vijay Madisetti	Internet of Things – A hands-on approach	Universities Press	2015
2	Olivier Hersent, David Boswarthick, Omar Elloumi	The Internet The Internet of Things – Key applications and Protocols‖	Wiley	2012(for Unit 2).
3	Jan Ho ller, Vlasios Tsiatsis , Catherine Mulligan, Karnouskos, Stefan Avesand, David Boyle	From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence	Elsevier	2014
4	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds),	Architecting the Internet of Things‖	Springer	2011
5	Michael Margolis	Cookbook, Recipes to Begin, Expand, and	O'Reilly Media	2011

WEBSITES:

1. www.mit.edu
2. www.nptel.com

FOR SEMESTER VI (ELECTIVE-III & IV)

19BEBME6E01 PHYSIOLOGICAL MODELLING 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students:

- To understand properties of systems and electrical analog.
- To discuss about transfer functions**.** .
- To build simple impedance concept**.** .

- To understand feedback systems**.**
- To develop simulation of biological systems**.**
- To gain knowledge about the concepts of physiological modelling.

INTENDED OUTCOME:

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

- Explain the concept of properties of systems and electrical analog
- Analyse various protocols about transfer functions.
- Build simple simple impedance concept
- Apply feedback systems.
- Analyse applications simulation of biological systems.
- Utilize concepts of physiological modelling..
- Learn the concept of the feedback systems with simulation.

UNIT I PROPERTIES OF SYSTEMS AND ELECTRICAL ANALOG

System concept, system properties – Resistance, storage, resistance – compliance, piece- wise linear approximation, electrical analog for compliance, thermal storage, step response of first order systems – resistance- compliance systems, and pulse response of first order systems

UNIT II TRANSFER FUNCTIONS

Transfer functions and its use, Study of transfer function of first order and second order systems, engineering concept in coupled system, example of Transformed signals.

UNIT III IMPEDANCE CONCEPT

Transfer functions with impedance concept, prediction of performance, identification of the system from impedance function, periodic signals, relationship between transfer function and sinusoidal response, evaluation of transfer function from frequency response.

UNIT IV FEEDBACK SYSTEMS

Characteristics of physiological feedback systems, stability analysis of systems.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS

Simulation of thermal regulation, pressure and flow control in circulation, occulo motor system, endocrinal system, functioning of receptors.

TEXTBOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Claudio Cobelli.,Ewart Carson	• Introduction To Modeling in Physiology and Medicine	Imprint Academic Press	2008

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	William B.Blesser	System approach to Bio-medicine	McGraw-Hill book co., NewYork	1969
2	Manfred Clynes and John H.Milsum	Bio-medical engineering system	McGraw-Hill book co., NewYork	1970
3	Michael C.K. Khoo	Physiological Control Systems - Analysis, Simulation	Prentice Hall of India Pvt. Ltd.,	2001
4	Douglas S.Regs	Control theory and physiological feedback mechanism	TheWilliam & Williams co., Baltimore	1970

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME6E02 TELEHEALTH TECHNOLOGY 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students:

- To infer the key principles for telemedicine and health.
- To define telemedical technology.
- To know telemedical standards, mobile telemedicine and it applications.
- To State the principles of clinical telehealth
- To understand the scope and benefits of Telemedicine
- To understand the limitations of Telemedicine and security in telemedicine applications

INTENDED OUTCOMES:

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

- Apply multimedia technologies in telemedicine.
- Explain Protocols behind encryption techniques for secure transmission of data.
- Utilize telehealth in healthcare.
- Outline the basic concepts involved in telemetry based transmission and reception
- Discuss the communication devices and Networks of telemedicine.
- Describe telehealth systems for secure transmission of medical data and retrieval of telemedicine based information.

UNIT I TELEMEDICINE AND HEALTH

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN,POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing. Clinical data – local and centralized.

UNIT III TELEMEDICAL STANDARDS

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

UNIT V TELEMEDICAL APPLICATIONS

Telemedicine access to health care services – health education and self care. · Introduction to robotics surgery, Telesurgery, Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and

costing, Usage of telemedicine.

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	.Norris, A.C	Essentials of Telemedicine and Telecare	Wiley	2002

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Wootton, R., Craig, J., Patterson, V	Introduction to Telemedicine. Royal Society of Medicine	Taylor & Francis	2006
2	O'Carroll, P.W., Yasnoff, W.A., Ward,	Public Health Informatics and Information Systems	Springer	2003
3	Ferrer-Roca, O., Sosa - Iudicissa, M.	Handbook of Telemedicine. Technology and Informatics	IOS Press (Studies in Health) Volume 54	2002
4	Simpson, W.	Video over IP, A practical guide to technology and applications	Focal Press Elsevier	2006
5	Bemmel, J.H. van, Musen, M.A.	Handbook of Medical Informatics	Springer	1997
6	Mohan Bansal	Medical Informatics	Tata McGraw-Hill	2004

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME6E03 CANCER BIOLOGY 3 0 0 3 100

OBJECTIVE

The goal of this course is for students:

- To infer the key principles for fundamentals of cancer biology
- To define principles of carcinogenesis technology.
- To know molecular cell biology of cancer.
- To State the principles of cancer metastasis**.**
- To understand the scope, benefits and limitations of new molecules for cancer therapy.
- To develop skills of the students in the area of Cancer Biology.

INTENDED OUTCOMES:

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

- Learnt about pathogenesis of cancer, identifications of cancer through tools developed by biotechnology research & molecules synthesized for cancer therapy. This will be very beneficial for the student to take up projects in Cancer Biology.
- Explain Protocols behind molecular cell biology of cancer.
- Utilize principles of cancer metastasis in healthcare.
- Outline the basic concepts involved in new molecules for cancer therapy
- Discuss the fundamentals of cancer biology
- Describe the area of Cancer Biology

UNIT I FUNDAMENTALS OF CANCER BIOLOGY

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity, Growth factors related to transformation, Telomerases.

UNIT IV PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V NEW MOLECULES FOR CANCER THERAPY

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Maly B.W.J	Virology A Practical Approach	“”, IRLl Press, Oxford	1987
2	Dunmock N.J And Primrose S.B	Introduction to Modern Virology	Blackwell Scientific Publications,	1988

REFERENCE:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Maly B.W.J	An Introduction Top Cellular And Molecular Biology of Cancer	Oxford Medical Publications	1991

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME6E04 BIOSIGNAL CONDITIONING CIRCUITS 3 0 0 3 100

COURSE OBJECTIVE

- To Design biomedical signal conditioning circuits
- To Work in various health related companies
- To Become familiar with various clinical devices
- To Promote research in the field of biomedical engineering
- To Work with and service various clinical devices
- To Excel in hardware and software applications in medical field

COURSE OUTCOME:

- gain in depth knowledge of fundamentals of operational amplifier circuits
- learn the various applications using operational amplifiers.
- understand various Filters
- Familiarise A/D and D/A convertors
- Apply op-amp in various conditioning circuits
- Need for digital circuits in biomedical field

UNIT 1 INTRODUCTION TO OPAMP

Introduction, Signal conditioning, 741 General purpose OPAMP: ideal characteristics, offset voltages and currents. Open & Closed Loop Configuration. Inverting, Non-Inverting, Summing, Voltage Follower, Integrator, differentiators, Log & Anti-Log Amplifiers, Differential Amplifiers, CMRR.

UNIT 2 APPLICATION OF OPAMPS

Comparator- Zero crossing detector, Inverting and non inverting comparator, Schmitt Trigger, Precision rectifiers- Half wave and Full wave rectifiers, Peak detectors, Monostable, Astable multivibrators, Sawtooth generator, Triangular waveform generator, Sine Wave Generators-RC Phase Shift Oscillator, Wein Bridge oscillator.

UNIT 3 FILTERS

Introduction- Analog Filters, Active Filters and Passive Filters, First order and Second order Low Pass Filters, High Pass Filters, Band Pass Filters- Narrow Band Pass, Wide band Pass Filters,, Band Reject Filters- Notch Filter, All Pass filters and higher Order filters- Design and applications.

UNIT 4 A/D AND D/A CONVERTERS

Sample and Hold circuit - D/A converters: Resistive divider and R-2R ladder networks, A/D converters: Counting type, Successive approximation, parallel comparator, Voltage to Current Converter, 555 Timer and its applications- Astable multivibrators and Monostable Multivibrator.

UNIT 5 AMPLIFIERS

Instrumentation amplifiers, Bridge Amplifiers, Bioelectric Amplifiers: - Properties desired, Isolation Amplifiers:- Battery Powered, Carrier, Optically Coupled, Current Loading, Chopper Stabilized amplifier, Input Guarding.

TEXT / REFERENCE BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Ramakant A Gayakwad	Operational Amplifiers & Linear Integrated Circuits	Prentice Hall	2000
2	Joseph J. Carr & John M. Brown	Introduction to Biomedical Equipment Technology	Pearson Education Pvt. Ltd, 4th edition	2001
3	Roy Choudhary	Linear Integrated Circuits	New Age International (P) Ltd,	2004

4	John P.Bentley	Principles of Measurement System	Longman Science & Technology	1995
5	Jacob Mill man	Micro Electronics	McGraw-Hill	1987
6	Robert Coughlin and Fredrer	Operational Amplifiers & Linear Integrated Circuits	Prentice Hall	2001

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME6E05 HOSPITAL WASTE MANAGEMENT 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students:

- To introduce the relevance of this course to the existing technology
- The student should be made to understand the principles, practices and areas of application in Hospital management
- To know the hazardous materials used in hospital and its impact on health.
- To get knowledge on biomedical waste management.

- To infer the hazards in biomedical waste management.
- To develop knowledge on facility safety and infection control.

INTENDED OUTCOME:

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

- Distinguish various waste disposal procedures and management.
- Understand the biomedical waste disposal concept.
- Explain the importance of supportive services.
- Demonstrate Biomedical Waste Management techniques.
- Elaborate the hazards in biomedical waste management.
- Apply knowledge on facility safety and infection control.

UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS

Healthcare Hazard Control : Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT II BIOMEDICAL WASTE MANAGEMENT

Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labelling, waste handling, collection, storage and transportation, treatment and disposal.

UNIT III HAZARDOUS MATERIALS

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

UNIT IV FACILITY SAFETY

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies,

Healthcare-Associated Infections, Medication Safety.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tweedy, James T.,	Healthcare hazard control and safety management	CRC Press_Taylor and Francis	2014
2	Anantpreet Singh, Sukhjit Kaur	Biomedical Waste Disposal	Jaypee Brothers Medical Publishers (P) Ltd	2012

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	R.C.Goyal	Hospital Administration and Human Resource Management	PHI – Fourth Edition	2006
2	V.J. Landrum	Medical Waste Management and disposal‖	Elsevier	1991

FOR SEMESTER VII (ELECTIVE-V)

19BEBME7E01 NEURAL ENGINEERING 3 0 0 3 100

OBJECTIVES:

- To discuss the physiological concepts of nerve impulse generation and Electromyography
- To discuss about EEG and its various applications
- To Explore Evoked potentials and its importance in medicine

- To introduce various techniques to study central and peripheral nerve function
- To discuss the electrophysiological evaluation in special situations
- To understand about neurotoxic disorders

INTENDED OUTCOMES:

- Understand the physiology behind generation of nerve impulses.
- Describe various techniques that are used to evaluate the functioning of central and peripheral nervous system.
- Differentiate between a normal and abnormal signal coming from a healthy and a diseased nervous system respectively.
- Analyse the EEG signals
- Learn about Evoked Potentials
- Understand Electrophysiological evaluation of sacral function

UNIT I NERVE EXCITABILITY AND ELECTROMYOGRAPHY

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings in Neurologic diseases: Chemotherapy induced neurotoxicity, Porphyric Neuropathy, Inflammatory Neuropathy and its Treatment, Spinal Cord Injury; Nerve conduction studies, Microneurography and its potential clinical applications. Clinical Electromyography (EMG), Quantitative EMG, Neuro muscular Ultrasound as a compliment to the electrodiagnostic evaluation, Electrophysiologic study of Disorders of Neuromuscular Junction:, H-Reflex and F-Reflex, Blink reflex and other cranial nerve reflexes, Electrophysiological evaluation of movement disorders, Evaluation of autonomic nervous system.

UNIT II ELECTROENCEPHALOGRAPHY

Electroencephalography (EEG): General Principles and Clinical Applications, Neonatal and Paediatric EEG, EEG Artefacts and Benign Variants, Video EEG monitoring for epilepsy, Invasive Clinical Neurophysiology in Epilepsy and movement disorders, Topographic mapping, Frequency analysis and other quantitative techniques in EEG, Intraoperative EEG monitoring during carotid endarterectomy and cardiac surgery, Magnetoencephalography.

UNIT III EVOKED POTENTIALS

Evoked Potentials and Related Techniques: Visual Evoked potentials (VEPs), Electroretinography and other diagnostic approaches to the Visual System, VEPs in infants and children, Brainstem Auditory Evoked Potentials (AEPs), Brainstem AEPs in infants and children, Somatosensory evoked potentials, Diagnostic and therapeutic role of Magnetic stimulation in neurology.

UNIT IV FUNCTIONAL NEUROIMAGING AND COGNITION

Historical and physiological perspective, Functional neuroimaging methods: PET and fMRI, Network analyses, Functional neuroimaging of: Attention, Visual recognition, Semantic memory,

Language, Episodic memory, Working memory, Cognitive aging, Neuro-psychologically impaired patients

UNIT V ELECTROPHYSIOLOGICAL EVALUATION IN SPECIAL SITUATIONS

Electrophysiological evaluation of sacral function: Bladder, bowel and sexual function, Vestibular laboratory testing, Polysomnographic evaluation of sleep disorders, Electrophysiologic evaluation of: brain death, patients in the intensive care unit, patients with suspected neurotoxic disorders.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Michael J. Aminoff, et. al.,	Aminoff‟ selectro diagnosis in Clinical Neurology‖, Sixth Edition	Elsevier Saunders	2012
2	Kim E. Baretteet. al.,	Ganong‘s review of Medical Physiology II	McGraw Hill Medical	2010

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Eric R. Kandelet. al.,	Principles of Neural Science	McGraw-Hill, New York	2012
2	R. Cooper, et. al,	Techniques in Clinical Neurophysiology: A Practical Manual	Elsevier, Amsterdam, The Netherlands	2005
3	Holodny, Andrei I., et al,	Functional neuroimaging: a clinical approach design	Informa Health Care	2008

19BEBME7E02 LASERS AND FIBER OPTICS IN MEDICINE 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To Understand Biomedical Laser principles and applications.
- To be familiar with optical properties of tissues
- To infer the knowledge of photonics
- To be exposed to Optical Holography
- To explain the various applications of Laser
- To understand photodynamic therapy.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Analyse the optical properties of tissues
- Use the Photonics instrumentation
- Apply lasers in different areas of medicine.
- Perceive the lasers in ophthalmology
- Discuss about optical hologram
- Explain the special techniques of Lasers.

UNIT I OPTICAL PROPERTIES OF THE TISSUES

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

UNIT II INSTRUMENTATION IN PHOTONICS

Instrumentation for absorption, scattering and emission measurements, excitation light sources –high pressure arc lamp, solid state LEDs, optical filters, polarisers, time resolved and phase resolved detectors.

UNIT III APPLICATIONS OF LASERS

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

UNIT IV OPTICAL HOLOGRAPHY

Wave fronts, interference patterns, principle of hologram, optical hologram, applications.

UNIT V SPECIAL TECHNIQUES

Near field imaging of biological structures, in-vitro clinical diagnostic, fluorescent spectroscopy, photodynamic therapy.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Leon Goldman, M.D., & R.James Rockwell, Jr.,	Lasers in Medicine	Gordon and Breach, Science Publishers Inc.,	1975
2	Abraham Katzir	Lasers and Optical Fibers in Medicine	Academic Press Edition	1998

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tuan Vo Dirh	Biomedical Photonics – Handbook	CRC Press, Bocaraton	2003
2	Glasser, O.,	Medical Physics -- Vol 1, 2, 3	Adam Hilgar Brustol Inc	1987
3	G.David Baxter	Therapeutic Lasers – Theory and practice	Churchill Livingstone Publications	2001

WEBSITES:

1. www.mit.edu
2. www.nptel.com

19BEBME7E03 PATIENT AND DEVICES SAFETY 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To provide basic knowledge on the concept of Healthcare Quality management towards continuous improvement of patient care
- To Understand hospital safety.
- To be familiar with electrical & fire safety.
- To infer the knowledge of regulatory requirement for health care.
- To be exposed to standardization of quality medical care in hospitals
- To explain the assessing quality health care

INTENDED OUTCOME:

Upon completion of this course, students will be able to:

- Make the students aware of the role of biomedical engineer in hospitals, especially in the management of electrical supply, maintenance of electrical safety.
- Analyse the hospital safety.
- Use the electrical & fire safety.
- Apply regulatory requirement for health care in different areas of medicine.
- Perceive the standardization of quality medical care in hospitals.
- Discuss about the assessing quality health care**.**

UNIT I STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS

Define Quality- Need for Standardization & Quality Management, TQM in Health care organization- Quality assurance methods, Q A in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments

UNIT II REGULATORY REQUIREMENT FOR HEALTH CARE

FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes.

UNIT III HOSPITAL SAFETY

Security & Safety of Hospital -Property, Staff & Patients, Radiation safety, Safety precautions, hazardous effects of radiation, allowed levels of radiation, ICRP regulations for radiation safety, Disposal of Biological waste.

UNIT IV ELECTRICAL & FIRE SAFETY

Sources of shocks, macro & micro shocks -Hazards, monitoring and interrupting the Operation from leakage current- Elements of fire, causes of fire , Action to be taken in case of fire in a Hospital.

UNIT V ASSESSING QUALITY HEALTH CARE

Patient Safety Organization- Governmental & Independent, Measuring Quality care – Evaluation of hospital services – six sigma way, Quality Assurance in Hospitals Sop's – Patient Orientation for Total Patient Satisfaction. 5S techniques.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Cesar A. Cacere & Albert Zana	The Practice of Clinical Engg.	Academic press, New York	1977
2	Webster J.G and Albert M.Cook	Clinical Engg, Principles & Practices, Prentice Hall Inc.,	Engle wood Cliffs, New Jersy	1979
3	B.M.Sakharkar	Principles of Hospital administration and Planning	JAYPEE Brothers, Medical Publishers	-

19BEBME7E04 RADIOLOGICAL EQUIPMENTS 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To understand generation of x-rays and its uses in imaging.
- To learn different types of radio diagnostic techniques.
- To know techniques used for visualizing different sections of the body.
- To infer radiation therapy methodologies and the radiation safety.
- To be familiar with electrical & fire safety.
- Know different diagnostic and therapeautic equipments

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Make the students aware of the role of medical x-ray equipment.
- Explain the different radio diagnostic and therapeutic techniques.
- Analyse the computed tomography Principles and applications.
- Use the MRI methods in appropriate situations.
- Apply nuclear medicine system in different areas of medicine.
- Perceive the standardization of quality radiation therapy and radiation safety in hospitals.

UNIT I MEDICAL X-RAY EQUIPMENT

Nature of X-rays- X-Ray absorption – Tissue contrast, X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography, Digital subtraction Angiography, Mammography.

UNIT II COMPUTED TOMOGRAPHY

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors-Viewing systems- spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.

UNIT III MAGNETIC RESONANCE IMAGING

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system- system magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields,

Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT IV NUCLEAR MEDICINE SYSTEM

Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

UNIT V RADIATION THERAPY AND RADIATION SAFETY

Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments- Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Steve Webb	The Physics of Medical Imaging	Adam Hilger, Philadelpia	1988
2	R.Hendee and Russell Ritenour	Medical Imaging Physics	Fourth Edition William, Wiley-Liss,	2002

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Gopal B. Saha	Physics and Radiobiology of Nuclear Medicine	Third edition Springer	2006
2	B.H.Brown, PV Lawford, R H Small	Medical physics and biomedical Engineering	CRC Press	1999
3	Myer Kutz,	Standard handbook of Biomedical Engineering and design	McGraw Hill	2003

WEBSITES:

1. www.mit.edu
2. www.nptel.com

FOR SEMESTER VIII (ELECTIVE-VI & VII)

19BEBME8E01 BIOLOGICAL SPECTROSCOPY 3 0 0 3 100

COURSE OBJECTIVE

- To develop the skills of students in the area of Biological spectroscopy.
- To learn various aspects of mass spectroscopy
- To Understand NMR Spectroscopy
- To Know various diffraction methods
- To Learn about Polarized light
- To understand optical rotation

COURSE OUTCOMES:

At the end of the course, the student would have learnt about

- various aspects of mass spectroscopy
- Understand about magnetic resonance imaging.
- Application of mass spectrometry
- X-ray diffraction.
- Familiarise optical rotation
- various kinds spectroscopic techniques to study biological system.

UNIT I OPTICAL ROTATORY DISPERSION

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins.

UNIT II NUCLEAR MAGNETIC RESONANCE

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – multidimensional NMR spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging.

UNIT III MASS SPECTROMETRY

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass sepctrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

UNIT IV X-RAY DIFFRACTION

Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – bragg reflection – unit cell – phase problem – anomalous diffraction – detemination of crystal structure – electron and neutron diffraction.

UNIT V SPECIAL TOPICS AND APPLICATIONS

Electron microscopy – transmission and scanning electron microscopy – scanning tunneling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Campbell I.D and Dwek R.A	Biological Spectroscopy	Benjamin Cummins and	1986
2	Atkins P.W	Physical Chemistry	Oxford IV Edition	1990

19BEBME8E02 ROBOTICS IN MEDICINE 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To understand the basics of Robotics, Kinematics.
- To understand the basics of Inverse Kinematics.
- To explore various kinematic motion planning solutions for various Robotic configurations.
- To study the trajectory planning for robot.
- To understand the task level programming
- To explore various applications of Robots in Medicine

OUTCOMES:

Upon completion of this course, students will be able to:

- Explain various kinds robotics techniques, vision, planning and applications.
- Outline the basic concept of robotics
- Identify and discuss the Robot Vision
- Describe about manipulators and kinematics.
- Demonstrate Task level programming
- Discuss the applications of robotic systems in medical field.

UNIT I INTRODUCTION

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNIT II KINEMATICS

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III ROBOT VISION

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV PLANNING

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT V APPLICATIONS

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics, Neurosurgery

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Robert Schilling	Fundamentals of Robotics-Analysis and control‖	Prentice Hall	2003
2	J.J.Craig	Introduction to Robotics‖,	Pearson Education	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Staugaard, Andrew C	Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning‖	Prentice Hall Of India	1987
2	Grover, Wiess, Nagel, Oderey	Industrial Robotics: Technology, Programming	McGraw Hill	1986.

		and Applications‖		
3	Wolfram Stadler	Analytical Robotics and Mechatronics‖	McGraw Hill,	1995
4	Saeed B. Niku,	Introduction to Robotics: Analysis, Systems, Applications‖	Prentice Hall	2001
5	K. S. Fu, R. C. Gonzales and C. S. G. Lee	Robotics‖	McGraw Hill	2008

19BEBME8E03 NANOTECHNOLOGY IN MEDICINE 3003 100

OBJECTIVE:

The goal of this course is for students

- To understand the basics of Materials in Medicine.
- To study and gain the knowledge of Nanotechnology in the field of medicine.
- To understand the basics of Biological Interactions with Materials.
- To explore various nano particles
- To learn Cellular Nano machines in Medical Diagnostics and Therapeutics.
- To explore about Application of nanotechnology in health monitoring systems.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Analyse various kinds of Nanomaterials.
- Analyse Safety Nanotherapeutic Device Components & Applications
- Applications of nanotechnology health care and medicine.
- Importance of nanoparticles for diagnostics
- Application of Cellular Nano machines in Medical Diagnostics and Therapeutics.
- Application of nanotechnology in health monitoring systems.

UNIT I INTRODUCTION

Cellular Nano machines and the Building Blocks of Life, A New Generation of Nano tools, Importance of various nano materials in health and medicine.

UNIT II NANOPARTICLES FOR DIAGNOSTICS

Nanoparticles in Medical Diagnostics and Therapeutics, Targeted drug delivery, Magnetic Nanoparticles as Contrast Agents for Medical Diagnosis, Liposome based delivery, Bio Inspired Nanomaterials for a New Generation of Medicine.

UNIT III THERAPEUTIC NANO DEVICES

Definition and scope, Synthetic Approaches: top-down versus bottom-up Approaches for Nanotherapeutic Device Components, Applications for Nano therapeutic Devices.

UNIT IV NANOSYSTEMS FOR HEALTHCARE MONITORING – I

Single-Molecule Detection Techniques for Monitoring Cellular Activity at the Nano scale Level, Nano probes, Integrated Cantilever-Based Biosensors for the Detection of Chemical and Biological Entities.

UNIT V NANOSYSTEMS FOR HEALTHCARE MONITORING – II

Nano pore Methods for DNA Detection and Sequencing, Nano tube Based Membrane Systems, micro/nano fluidic systems for bio-object sorting, single chip electrophoresis system.

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tuan Vo-Dinh	Nanotechnology in Biology and Medicine: Methods, Devices and Applications	CRC press	2006

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication

1	Chala Kumar	Bio functionalization of nanomaterials	Wiley	2005
2	Charles Pooles, Frank J. Ownes	Introduction to Nanotechnology	Wiley	2003
3	Bharat Bhushan	Handbook of Nanotechnology	Springer	2003

19BEBME8E04 VIRTUAL REALITY AND AUGMENTED REALITY 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To impart the fundamental aspects, principles of virtual reality technology.
- To gain knowledge about applications of virtual reality.
- To introduce the relevance of this course to the existing technology through demonstrations and applications.
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality
- To choose Virtual Reality application areas

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Understand the basic concepts of Virtual reality
- Infer the importance of virtual reality
- Comprehend the significance Virtual reality in present scenario
- Analyse VR on the mobile and VR on the web.
- Design of various modeling concepts.
- Develop the Virtual Reality applications in different areas

UNIT I INTRODUCTION

The three I‘s of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional

position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback..

UNIT II VR DEVELOPMENT PROCESS

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB & VR ON THE MOBILE

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

UNIT V APPLICATIONS

Medical applications-military applications-robotics applications- Advanced Real time Trackingother applications- games, movies, simulations, therapy.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	C. Burdea & Philippe Coiffet	Virtual Reality Technology‖	Second Edition, Gregory,	2008
2	Jason Jerald	. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool	New York, NY, US	-

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication

1	Dieter Schmalstieg & Tobias Hollerer	Augmented Reality: Principles and Practice (Usability)	Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States	2016
2	Steve Aukstakalnis,	Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)	Addison-Wesley Professional 1 edition,	2016
3	Robert Scoble & Shel Israel	The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything	Patrick Brewster,Press	2016
4	Tony Parisi,	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile	O'Reilly Media; 1 edition	2015
5	Tony Parisi	Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for	O'Reilly Media; 1 edition	2014
6	Jos Dirksen	Learning Three.js: The JavaScript 3D Library for WebGL	Packt Publishing - ebooks Account; 2nd Revised ed. Edition	2015

19BEBME8E05 SPEECH PROCESSING 3 0 0 3 100

OBJECTIVES:

The goal of this course is for students

- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
- To introduce speech production and related parameters of speech.
- To impart the fundamental aspects speech analysis.
- To gain knowledge about applications of speech modeling.
- To understand different speech modeling procedures such as Markov and their implementation issues.
- To infer the knowledge of Text-to-Speech Synthesis

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Model speech production system and describe the fundamentals of speech.
- Extract and compare different speech parameters.
- Choose an appropriate statistical speech model for a given application.
- Design a speech recognition system.
- Use different speech synthesis techniques.
- Develop the speech recognition applications in different areas

UNIT I BASIC CONCEPTS

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

UNIT II SPEECH ANALYSIS

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures– mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT III SPEECH MODELING

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

UNIT V SPEECH SYNTHESIS

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Lawrence Rabiner and Biing-Hwang Juang	Fundamentals of Speech Recognition	Pearson Education	2003
2	Daniel Jurafsky and James H Martin	Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition	Pearson Education	2002
3	Frederick Jelinek	Statistical Methods of Speech Recognition	MIT Press	1997

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Steven W. Smith	The Scientist and Engineer″s Guide to Digital Signal Processing	California Technical Publishing	1997
2	Thomas F Quatier	Discrete-Time Speech Signal Processing – Principles and Practice	Pearson Education	2004
3	Claudio Becchetti and Lucio Prina Ricotti	Speech Recognition	John Wiley and Sons	1999
4	Ben Gold and Nelson Morgan	Speech and audio signal processing, Processing and Perception of Speech and Music	Wiley- India Edition	2006

19BEBME8E06 RAPID PROTOTYPING 3 0 0 3 100

OBJECTIVE:

- Generating a good understanding of RP history, its development and applications.
- To expose the students to different types of Rapid prototyping processes,
- Materials used in RP systems and reverse engineering.
- To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields
- Understand Selective Laser Sintering
- Know Direct shell production casting

OUTCOME:

- To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields
- Generating a good understanding of RP history, its development and applications.
- To expose the students to different types of Rapid prototyping processes,
- Materials used in RP systems and reverse engineering.
- Familiarise Laser Engineered Net Shaping (LENS).
- Know medical data processing

UNIT I INTRODUCTION

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format – Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS

9Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS

Nature of material – type of material – polymers, metals, ceramics and composites- liquid based materials, photo polymer development – solid based materials, powder based materials - case study.

UNIT V REVERSE ENGINEERING and NEW TECHNOLOGIES

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications – Case study.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Rafiq I. Noorani	Rapid Prototyping – Principles and	Wiley & Sons	2006
2	Chua C.K, Leong K.F and Lim C.S	Rapid Prototyping: Principles and Applications	second edition, World Scientific	2003

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	N.HOPKINSON, R.J.M, HAUGE, P M, DICKENS	Rapid Manufacturing – An Industrial revolution for the digital age	Wiley	2006

2	IAN GIBSON	Advanced Manufacturing Technology for Medical	Wiley	2006
3	Paul F.Jacobs	Rapid Prototyping and Manufacturing, "Fundamentals of Stereo lithography	McGraw Hill	1993
4	D.T.Pham and S.S. Dimov	Rapid Manufacturing	Springer Verlog	2001

19BEBME8E07 **BIO MEMS** **3 0 0 3** **100**

OBJECTIVES:

The goal of this course is for students

- To gain knowledge on the principles and application of BioMEMS
- To Learn various MEMS fabrication techniques.
- To Understand different types of sensors and actuators and their principles of operation at the micro scale level.
- To Know the application of MEMS in different field of medicine
- To Comprehend the characteristics of fluid flow and actuation through micro channels.
- To Explain the need and use of CAD for MEMS design

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Discuss various MEMS fabrication techniques.
- Explain different types of sensors and actuators and their principles of operation at the micro Scale level.
- Analyse the Properties of piezoelectric materials
- Apply MEMS in different field of medicine.
- Acquainted with micro fluidic systems
- Design MEMS devices for different medical applications.

UNIT I MEMS MATERIALS AND FABRICATION 9

Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure

sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT IV MICROFLUIDIC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers

UNIT V APPLICATIONS OF BIOMEMS 9

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery

Total Periods : 45

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Tai Ran Hsu	MEMS and Microsystems Design and Manufacture	Tata McGraw Hill Publishing Company, New Delhi	2002
2	Wanjun Wang, Stephen A.Soper	BioMEMs: Technologies and Applications	CRC Press, New York	2007

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Marc J. Madou	Fundamentals of Microfabrication: the Science of Miniaturization	CRC Press	2002
2	Nadim Maluf, Kirt Williams	An introduction to Microelectro Mechancial Systems Engineering	Second Edition, Artech House Inc, MA,	2004
3	Chang Liu,	Foundations of MEMS	Pearson Education International, New Jersey, USA	2006
4	Nitaigour Premchand Mahalik	MEMS	Tata McGraw Hill Publishing Company, New Delhi	2007

WEBSITE:

1. www.mit.edu
2. www.nptel.com

19BEBME8E08 INTELLECTUAL PROPERTY RIGHTS 3 0 0 3 100

OBJECTIVES:

The student should be made to:

- Learn how to value intangible assets, taking into account their commercial potential and legal status.
- Explore the legal & business issues surrounding marketing of new products related to technology.
- Review an intellectual property portfolio and comprehend the extent of their protection.
- Develop a business plan that advances the value of their intellectual property portfolio
- Develop a strategy of marketing their intellectual property and understand some negotiation basics.
- Explain some of the limits of their intellectual property rights and comprehend some basic legal pitfalls.

INTENDED OUTCOMES:

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

- Review an intellectual property portfolio and comprehend the extent of their protection.
- Describe the registration of copy rights, trademarks, patents and industry
- Develop a business plan that advances the value of their intellectual property portfolio
- Analyse International convention relating to Intellectual Property
- Distinguish Indian Position Vs WTO and Strategies relating to Intellectual Property
- Explain some of the limits of their intellectual property rights and comprehend some basic legal pitfalls

UNIT I INTRODUCTION

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (i) Movable Property (ii) Immovable Property and (iii) Intellectual Property.

UNIT II PATENTS, COPYRIGHTS AND TRADEMARKS

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures.

UNIT III INTERNATIONAL STANDARDISATION

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement on Trade and Tariff (GATT).

UNIT IV INDIAN STRATEGIES

Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO-Patent Ordinance and the Bill – Draft of a national Intellectual Property Policy – Present against unfair competition.

UNIT V CASE STUDIES

Case Studies on – Patents (Basumati rice, turmeric, Neem, etc.) – Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

TEXT BOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Subbaram N.R	Handbook of Indian Patent Law and Practice	S. Viswanathan, Printers and Publishers Pvt. Ltd	1998

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Eli Whitney	United States Patent Number: 72X	Cotton Gin	March 14, 1794
2	Derwent IP Matters	Using the Internet for non-patent prior art searches	-	July 2000.

19BEBME8E09 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 3 0 0 3 100

OBJECTIVE:

The goal of this course is for students

- To impart Adequate knowledge on their presentation and structures of artificial intelligence and to study in depth about the expert systems and its tools.
- To Learn various knowledge representation techniques.
- To Understand different types slot & filler structures
- To Know the application of expert systems
- To Comprehend the characteristics of tools for building expert systems .
- To Explain the need and use of AI.

INTENDED OUTCOMES:

Upon completion of this course, students will be able to:

- Provides a review on artificial intelligence and internal representation.
- Discuss various knowledge representation techniques..
- Explain different types of slot & filler structures
- Analyse the application of expert systems
- Develop a knowledge representation portfolio
- Develop a strategy of designing expert systems.

UNIT I AI & INTERNAL REPRESENTATION

The AI problem– What is AI technology– Level of the Model–Criteria for Success problems, Problem Spaces & Searches & Heuristic Search Technology Problem as a State Space Search–Production Systems– Production System Characteristics– Generate & Test– Hill Climbing –Best First Search– Constraint Satisfaction– Means End Analysis.

UNIT2 KNOWLEDGE REPRESENTATION

Issues in Knowledge Representation – Using Predicate Logic– Representing Simple Facts in Logic, Representing Instance & Isa Relationship–Computable Functions & I Predicates–Representing Knowledge Using Rules: Procedural Vs. Declarative Knowledge– Forward Vs. Backward Reasoning.

UNIT3 SLOT & FILLER STRUCTURES

Weak Slot &Filler– Semantic Nets– Frames Strong & filler Structures– Scripts– CYC-CYCL

UNIT4 EXPERT SYSTEMS

What are Expert Systems– Knowledge Representation in Expert Systems– Symbolic Computation–Rule based Systems

UNIT5 TOOLS FOR BUILDING EXPERT SYSTEMS

Using Domain Knowledge– Knowledge Acquisition– Design for Explanation–Black Board Architecture– Truth Maintenance Systems–Machine Learning– Case based Reasoning

TEXT/REFERENCEBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Elaine Rich, Kevin Knight	Artifical Intelligence	2nd Edition, Tata McGraw Hill	1992
2	Peter Jackson,	Introduction to Expert Systems	3rd Edition,Addison Wesley,1st Indian Reprint	2000

19BEBME8E10 NEURAL NETWORKS AND APPLICATIONS 3003 100

OBJECTIVES:

The goal of this course is for students :

- To understand biological and statistical foundations of neural networks,
- To explain the fundamentals of neural networks.
- To introduce the basic concepts of neural networks and its applications in various domain
- To educate about supervised and unsupervised learning process
- To have a solid understanding of various neural network model
- To learn the concepts of Self-organizing map (SOM) algorithm

INTENDED OUTCOMES:

At the end of the course the students will be able to

- Understand the basic concepts of neural networks and its applications in various domains
- Gain knowledge about learning process in Neural Networks
- Analyse neural network architectures
- Design using Adaptive Resonance Theory (ART) technique
- Design Back Propagation and Hopfield network.
- Gain knowledge on SOM concepts.

UNIT I NEURON MODEL NETWORK ARCHITECTURE

Neuron model – single input neuron –activation function – multiple input neuron neural networks viewed as directed graphs -feedback - network architectures – knowledge representation – linear and non- linear separable problem(XOR)

UNIT II LEARNING PROCESS

Error – correction learning – memory based learning - Hebbian learning-competitive learning-Boltzmann learning-credit assignment problem-supervised and unsupervised learning-adaptation statistical learning theory.

UNIT III PERCEPTRONS

Single layer perceptron-Adaptive filtering-unconstrained optimization-Least-mean square algorithm-Learning curve-Annealing Technique-perception convergence theorem- Relationship between perceptron and Baye's classifier-Back propagation algorithm- Network pruning techniques-supervised learning viewed as an optimization problem convolutional network. Application to Adaptive Prediction and character recognition.

UNIT IV ATTRACTOR NEURAL NETWORK AND ART

Hopfield model-BAM model-BAM stability-Adaptive BAM -Lyapunov function-effect of gain-Hopfield design-Application to TSP problem-ART- layer 1-layer 2-orienting subsystem-Leaning lawL1-L2- Leaning law L2-L1-ART algorithm-ARTMAP

UNIT V PRINCIPAL COMPONENT ANALYSIS AND SELF ORGANIZATION

Principle of self organization-Principle Component analysis-Adaptive PCA using Lateral inhibition-Two classes of PCA algorithm-Two basic feature- mapping model-self organizing map-SOM Algorithm properties of the feature map-LVQ-Hierarchical vector Quantization. Applications of self-organizing maps: The Neural Phonetic Typewriter- Learning Ballistic Arm Movements.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Freeman J.A., Skapura D.M	Neural Networks, Algorithms, Applications, and Programming Techniques	Addition Wesley	2005
2	Laurene Fausett	Fundamentals of Neural Networks: Architectures, Algorithms, and Applications	Pearson/ Prentice Hall	-

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Simon Haykin	Neural Networks and Learning Machines	3rd Edition-Pearson/ Prentice Hall	2009
2	Robert J Schalkoff	Artificial Neural Networks	McGraw Hill	1997

LIST OF OPEN ELECTIVES OFFERED BY
SCIENCE AND HUMANITIES DEPARTMENT

19BESHOE01 PROBABILITY AND RANDOM PROCESS 3 0 0 3 100

COURSE OBJECTIVES:

- To gain knowledge inmeasures of central tendency.
- To provide necessary basic concepts in probability and random processes.
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.

COURSE OUTCOMES:

- Learners acquire skills in handling situations involving more than one random variable and functions of random variables.
- The students will have an exposure of various distribution functions, correlation and spectral densities.
- To understand the significance of linear systems with random inputs.
- Apply the concept random processes in engineering disciplines.
- Understand and apply the concept of correlation and spectral densities.
- The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.

UNIT I MEASURES OF CENTRAL TENDENCY AND PROBABILITY (9)

Measures of central tendency – Mean, Median, Mode - Standard DeviationProbability – Random variable - Axioms of probability - Conditional probability – Total probability – Baye's theorem.

UNIT II STANDARD DISTRIBUTIONS (9)

Functions of a random variable - Binomial, Poisson, Uniform, Exponential, Gamma(one Parameter only) and Normal distributions - Moment generating functions, Characteristic function and their properties – *Chebyshev's inequality*.

UNIT III TWO DIMENSIONAL RANDOM VARIABLES (9)

Joint distributions - Marginal and conditional distributions - Probability mass function - Probability density functions – Covariance - Correlation and regression

UNIT IV CLASSIFICATION OF RANDOM PROCESS (9)

Definition and examples - first order, second order, strictly stationary, wide – sense stationary and Ergodic processes - Markov process - Binomial, Poisson and Normal processes - Sine wave process.

UNIT V CORRELATION AND SPECTRAL DENSITIES (9)

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function - Linear time invariant system - System transfer function –Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

Total: 45

TEXTBOOK:

S.NO.		Author(s) Name	Title of the book	Publisher	Year of publicatio
1		Peebles Jr, P. Z	Probability Random Variables and Random Signal	Tata McGraw-Hill Pubishers, New Delhi.	2002

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Ross, S	A first Course in Probability	Pearson Education, New Delhi (Chap 2 to 8)	2012
2	Gupta, S.C. and Kapoor, V.K	Fundamentals of Mathematical Statistics	Chand and Sons, New Delhi.	2014
3	Veerarajan,T.	Probabilitiy, Statistics and Random process	Tata McGraw-Hill Education pvt. Ltd., New Delhi	2008
4	Henry Stark and John W. Woods	Probability and Random Processes with Applications to Signal Processing	Pearson Education, Third edition, Delhi	2002

1. www.cut-the-knot.org/probability.shtml
2. www.mathcentre.ac.uk
3. www.mathworld.Wolfram.com

19BESHOE02 FUZZY MATHEMATICS 3 0 0 3 100

COURSE OBJECTIVES:

- Be able to understand basic knowledge of fuzzy sets and fuzzy logic
- Be able to apply basic knowledge of fuzzy operations.
- To know the basic definitions of fuzzy relations
- Be able to apply basic fuzzy inference and approximate reasoning
- To know the applications of fuzzy Technology.
- To understand the concepts of Probability Measures vs Possibility Measures

COURSE OUTCOME:

- To gain the main subject of fuzzy sets.
- To understand the concept of fuzziness involved in various systems and fuzzy set theory.
- To gain the methods of fuzzy logic.
- To comprehend the concepts of fuzzy relations.
- To analyze the application of fuzzy logic control to real time systems.
- The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

UNIT I FUZZY SETS (9)

Fuzzy Sets : Basics Classical sets vs Fuzzy Sets – Need for fuzzy sets – Definition and Mathematical representations – Level Sets – Fuzzy functions - Zadeh's Extension Principle

UNIT II OPERATIONS ON FUZZY SETS (9)

Operations on Fuzzy Sets Operations on [0, 1] – Fuzzy negation, triangular norms, tconorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

UNIT III FUZZY RELATIONS (9)

Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

UNIT IV FUZZY MEASURES (9)

Possibility Theory Fuzzy Measures – Evidence Theory – Necessity and Belief Measures – Probability Measures vs Possibility Measures

UNIT V FUZZY INFERENCE (9)

Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

Total: 45

TEXTBOOK:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	George J Klir and Bo Yuan	Fuzzy Sets and Fuzzy Logic: Theory and Applications	Prentice Hall of India, New Delhi.	2003

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Zimmermann H.J.	Fuzzy Set Theory and its Applications	Kluwer Academic publishers, USA.	2001
2	Michal Baczynski and BalasubramaniamJayaram	Fuzzy Implications	Springer-Verlag publishers, Heidelberg	2008
3	Kevin M Passino and Stephen Yurkovich	Fuzzy Control	Addison Wesley Longman publishers, USA	1998

WEBSITES:

1. www.mathcentre.ac.uk
2. www.mathworld. Wolfram.com
3. www.calvin.edu/~pribeiro/othrlnks/Fuzzy/fuzzysets.htm

19BESHOE03 LINEAR ALGEBRA 3 0 0 3 100

COURSE OBJECTIVES:

- To introduce the basic concepts of vector space
- To know the fundamentals of linear Algebra
- To solve system of linear equations
- To study about the linear transformations
- To introduce the concepts of inner product spaces
- To understand the importance of Linear Algebra and its applications in branches of Mathematics

COURSE OUTCOMES:

The student will be able to

- To explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- To describe the fundamental concepts of Eigen values and Eigen vectors by using Power method.
- To apply the fundamental concepts in their respective engineering fields
- To visualize linear transformations as matrix form
- To recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
- To articulate the importance of Linear Algebra and its applications in branches of Mathematics

UNIT I VECTOR SPACES (9)

General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space,

UNIT II EIGEN VALUES AND EIGEN VECTORS (9)

Eigen values and Eigen vectors - Diagonalization - Power method - QR decomposition

UNIT III SYSTEM OF LINEAR EQUATIONS (9)

Direct methods, Gauss elimination method, Gauss Jordan method, Crout's method, iterative methods, Gauss-Jacobi method, Gauss–Seidel method, convergence criteria.

UNIT IV LINEAR TRANSFORMATIONS (9)

Linear Transformations - The Null Space and Range - Isomorphisms - Matrix Representation of Linear Transformations – Similarity - Eigenvalues and Eigenvectors Eigen values and Eigen vectors - Diagonalization

UNIT V INNER PRODUCT SPACES (9)

The Dot Product on R^n and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kreyszig,E	Advanced Engineering Mathematics	John Wiley & Sons, New Delhi.	2014
2	ShahnazBathul	Text book of Engineering Mathematics (Special Functions and Complex Variables)	PHI Publications, New Delhi.	2009

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Kreyszig,E	Advanced Engineering Mathematics	John Wiley & Sons, New Delhi.	2014
2	Anton and Rorres	Elementary Linear Algebra, Applications version	Wiley India Edition, New Delhi.	2012
3	Jim Defranza, Daniel Gagliardi	Introduction to Linear Algebra with Application	Tata McGraw-Hill, New Delhi.	2008

WEBSITES:

1. www.sosmath.com
2. www.nptel.ac.in
3. www.mathworld.wolfram.com

19BESHOE04 ENGINEERING ACOUSTICS 3 0 0 3 100

COURSE OBJECTIVES:

- To disseminate the fundamentals of acoustic waves. (K)
- To inculcate the characteristics of radiation and reception of acoustic waves. (K)
- To divulge knowledge on the basics of pipe resonators and filters.(S)
- To introduce the features of architectural acoustics.**(S)**
- To impart the basic knowledge of transducers and receivers.(K)
- To introduce the applications of Engineering acoustics

COURSE OUTCOME:

- Develop the idea of the fundamentals of acoustic waves.
- Apply the concepts of radiation and reception of acoustic waves.
- Explain the basic ideas of pipe resonators and filters.
- Illusrate the basics of architectural acoustics..
- Illustrate the transducers and receivers and its applications in various electronic devices.
- Apply the knowledge inputs of the course for engineering applications.

UNIT I INTRODUCTION 9

Acoustics waves – Linear wave equation – sound in fluids – Harmonic plane waves - Acoustics intensity – Specific acoustic impedance – spherical waves – Describer scales.Reflection and Transmission:Transmission from one fluid to another normal and oblique incidence –method of images.

UNIT II RADIATION AND RECEPTION OF ACOUSTIC WAVES 9

Radiation from a pulsating sphere – Acoustic reciprocity – continuous line source radiation impedance - Fundamental properties of transducers.Absorption and attenuation of sound. Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient

UNIT III PIPES RESONATORS AND FILTERS 9

Resonance in pipes - standing wave pattern absorption of sound in pipes – long wavelength limit – Helmoltz resonator - acoustic impedance - reflection and transmission of waves in pipe - acoustic filters – low pass, high pass and band pass. Noise, Signal detection, Hearing and speech. Noise, spectrum level and band level – combing band levels and tones – detecting signals in noise – fundamental properties of hearing – loudness level and loudness – pitch and frequency – voice.

UNIT IV ARCHITECTURAL ACOUSTICS 9

Sound in endosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound

sources in live rooms – acoustics factor in architectural design. Environmental Acoustics: Highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design of portions.

UNIT V TRANSDUCTION **9**

Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker– horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers

Total: 45

TEXTBOOK:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	LawerenceE.Kinsler, Austin R.Frey,	Fundamentals of Acoustics	John Wiley & Sons	2000

REFERENCE:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	F. AltonEverest & Ken Pohlmann	Master Handbook of Acoustics	McGraw Hill Professional	2014

WEBSITES:

1. www.acousticalsociety.org
2. www.acoustics-engineering.com
3. www.nptel.ac.in
4. www. ocw.mit.edu

19BESHOE05 SOLID WASTE MANAGEMENT 3 0 0 3 100

Course Objectives:

- To make the students conversant with basics of Solid waste sand its classification.
- To make the student acquire sound knowledge of different treatments of solid wastes.
- To acquaint the student with concepts of waste disposals.
- To develop an understanding of the basic concepts of Hazardous waste managements.
- To acquaint the students with the basics of energy generation from waste materials.
- To understand the chemical principles in field of engineering and technology

Course Outcome:

- Outline the basic principles of Solid waste and separation of wastes (K)
- Identify the concepts of treatment of solid wastes(S)
- Identify the methods of wastes disposals.(S)
- Examine the level of Hazardousness and its management. (S)
- Examine the possible of the energy production using waste materials. (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I SOLID WASTE 9

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

UNIT II WASTE TREATMENT 9

Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT III WASTE DISPOSAL 9

Sanitary Land Fill Method of Solid Waste Disposal – Land Fill Classficaition, Types, Methods &Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfill Remediation

UNIT IV HAZARDOUS WASTE MANAGEMENT 9

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling -Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediaiton, risk assessment.

UNIT V ENERGY GENERATION FROM WASTE 9

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, Energy recovery systems. Biological & Chemical conversion

technologies – Aerobic composting, low solids.Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformation processes.

Total: 45

TEXTBOOK:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	Dara.S.S,Mishra.D.D	A Text book of Environmental Chemistry and Pollution Control	S.Chand and Company Ltd., New Delhi.	2011

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	Naomi B. Klinghoffer and Marco J. Castaldi	Waste to Energy Conversion Technology (Woodhead Publishing Series in Energy)	Woodhead Publishing Ltd., Cambridge, UK	2013
2	Frank Kreith, George Tchobanoglous	Hand Book of Solid Waste Management- 2nd edition	McGraw Hill Publishing Ltd., Newyork	2002
3	Shah, L Kanti	Basics of Solid & Hazardous Waste Management Technology	Prentice Hall (P) Ltd., New Delhi.	1999

WEBSITES:

1. www.iitk.ac.in/3inetwork/html/reports/IIR2006/Solid_Waste.
2. http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/
3. www.alternative-energy-news.info/technology/garbage-energy/
4. nzic.org.nz/Chem Processes/environment/

19BESHOE06 GREEN CHEMISTRY 3 0 0 3 100

COURSE OBJECTIVES:

- To make the students conversant about the green chemistry
- To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
- To acquaint the student with concepts of green technology.
- To develop an understanding of the basic concepts of renewable energy resources.
- To acquaint the students with the basics information on catalysis.
- To understand the chemical principles in in field of engineering and technology

COURSE OUTCOMES:

- Outline the basic principles of green chemistry (K)
- Examine the different atom efficient process and synthesis elaborately (S)
- Apply the concepts combustion of green technology (S)
- Identify and apply the concepts of renewable energy(S)
- Apply the concepts of green catalysts in the synthesis (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I INTRODUCTION TO GREEN CHEMICAL PRINCIPLES 9

Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II ATOM EFFICIENT PROCESSES 9

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis.

UNIT III BIOTECHNOLOGY AND GREEN CHEMISTRY 9

Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air.Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNIT IV RENEWABLE RESOURCES 9

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion.

UNIT V CATALYSIS IN GREEN CHEMISTRY 9

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

Total: 45

TEXTBOOKS:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	Sanjay K. Sharma, AckmezMudhoo	Green Chemistry for Environmental Sustainability	CRC Press,London	2010
2	Ahluwalia V. K. and M.Kidwai	New Trends in Green Chemistry 2^{nd} edition	Anamaya publishers, New Delhi.	2007

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	Dr. SunitaRatan	A Textbook of Engineering Chemistry	S.K. Kataria and Sons., New Delhi.	2012
2	MukeshDoble. Ken Rollins, Anil Kumar	Green Chemistry and Engineering, 1^{st} edition	Academic Press, Elesevier., New Delhi.	2007
3	Desai K. R.	Green Chemistry	Himalaya Publishing House, Mumbai.	2005
4	Matlack A. S.	Introduction to Green Chemistry	Marcel Dekker: New York	2001

WEBSITES:

1. http://www.organic-chemistry.org/topics/green-chemistry.shtm
2. http://www.essentialchemicalindustry.org/processes/green-chemistry.html
3. http://www.chm.bris.ac.uk/webprojects2004/vickery/green_solvents.htm
4. http://www.epa.gov/research/greenchemistry/
5. http://www.amazon.in/Green-Chemistry-Catalysis

19BESHOE07 APPLIED ELECTROCHEMISTRY L T P C

30 03

Objectives:

- To make the students conversant with the information on electrochemical material.
- To make the student acquire sound knowledge of conducting polymers.
- To acquaint the student with concepts of Energy storage devices.
- To develop energy storage devices.
- To impart knowledge on basic principles of solar cells and its applications
- To understand about electrochemical material science

Course Outcomes:

- Outline the basic principles of chemistry in electrochemical material (K)
- Examine the properties of conducting polymers(S)
- Apply the concepts of electrochemistry in storage devices.(S)
- Identify the concepts of storage devices and its applications. (S)
- Apply the suitable materials for the manufacturing of storage devices. (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I METAL FINISHING 9

Fundamental principles, surface preparation-Electroplating of copper, nickel, chromium, zinc and precious metals (gold & silver)- Electroplating for electronic industry- Alloy plating, brass plating- Electro less plating of nickel- anodizing – Electroforming – Electro winning.

UNIT II CONDUCTING POLYMERS AND ELECTROCHEMICALS 9

Electropolymerization- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers- poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

UNIT III BATTERIES AND POWER SOURCES-I 9

Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNIT IV BATTERIES AND POWER SOURCES-II 9

Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries, Lithium ion batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNIT V ELECTROCHEMICAL MATERIAL SCIENCE 9

Solar cells- Preparation of CdS/Cu_2S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics.

Total: 45

TEXTBOOKS:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	Cynthia G. Zoski	Hand Book of Electrochemistry	Academic Press, Elesevier., UK	2007
2	D.Pletcher and F.C.Walsh	Industrial Electrochemistry	Chapman and Hall, London	1990

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	M. Barak	Electrochemical Power Sources	I.EEE series, Peter Peregrinius Ltd, Steverage, U.K.	1997
2	Bruno Scrosati	Applications of Electroactive Polymers	Chapman & Hall, London	1993
3	K.L. Chopra and I. Kaur	Thin Film Devices and their Application	Plenum Press, New York.	1983
4	M.M.Baizer	Organic Electrochemistry	Dekker Inc. New York	1983

WEBSITES:

1. http://www.anoplate.com/finishes/
2. http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html
3. http://inventors.about.com/od/sstartinventions/a/solar_cell.htm

19BESHOE08 INDUSTRIAL CHEMISTRY L T P C

30 03

Course Objectives:

- To make the students conversant with cement and lime and its uses.
- To make the student acquire sound knowledge of abrasives and refractories.
- To acquaint the student with concepts of inorganic chemicals.
- To develop an understanding of the basic concepts explosives.
- To acquaint the students with the basics of agriculture chemicals.
- To understand the chemical principles in in field of engineering and technology

Course Outcomes:

- Outline the basic chemistry of cement and lime (K)
- Examine the uses of abrasives and refractories (S)
- Identify the usage of the inorganic chemicals. (S)
- Identify the concepts of explosives and smoke screens(S)
- Identify the usage of the agriculture chemicals(S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I CEMENT AND LIME 9

Manufacture of Portland cement – settling of hardening of portland cement – regauging cement – effect of fineness on setting and hardening – freezing – high early strength cement – high alumina cement Lime – raw materials- manufacture – slaking – lime mortar – types of lime – high – calcium or fat lime – calcium lime or lean lime – magnesian lime – dolomitic lime – hydraulic lime.

UNIT II ABRASIVES AND REFRACTORIES 9

Abrasives – hard abrasives – siliceous abrasives – soft abrasives – artificial abrasives – uses. Refractories – definition – classification – acid refractories – basic refractories – neutral refractories – properties – uses.

UNIT III INORGANIC CHEMICALS 9

Common salt and soda ash – manufacture – different grades – products – alkalis – Na_2CO_3, caustic soda and chlor-alkali industry – manufacture principles of electrolytic process – chlorine – storage. Hydrochloric acid – manufacture – absorption – uses, sulphur and sulphuric acid – extraction of sulphur – manufacture of H_2SO_4 – chamber – contact processes – industrial uses.

UNIT IV EXPLOSIVES 9

Explosives – uses – properties and tests – explosives for war – nitrocellulose – picric acid and T.N.T. – industrial explosives – nitroglycerin and dynamites – black powder – smoke screens – incendiaries – gas mask.

UNIT V AGRICULTURE CHEMICALS 9

Fertilizers – organic and inorganic – ammoniated superphosphates, sodium nitrate, solid pellets – potassium salts – pesticides – fungicides – herbicides – their preparations and characteristics – environmental impacts.

Total: 45

TEXTBOOKS:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	Harikrishan	Industrial Chemistry	Goel Publishing House, Meerut.	2014
2	B.K. Sharma	Industrial Chemistry	Goel Publishing House, Meerut.	2000

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	B.N.Chakrabarty	Industrial Chemistry	Oxford and IBH Publishing CO. New Delhi.	1998
2	James A. Kent	Hand Book of Industrial Chemistry, 9th edition	Van Nostrand Reinhold, New	1992
3	R.N. Sherve	Chemical Process Industries	McGraw-Hill, Kugakuisha Ltd., Tokyo.	1984
4	S.D. Shukla and G.N. Pandy	A Text book of Chemical Technology	Vikas Publishing House (P) Ltd, New Delhi	1979

WEBSITES:

1. http://en.wikipedia.org/wiki/Cement
2. http://www.hon.ch/HONselect/Selection/D01.html
3. http://fas.org/man/dod-101/navy/docs/fun/part12.htm
4. http://toxics.usgs.gov/topics/agchemicals.html

19BESHOE09 ENGLISH FOR TECHNOCRATS L T P C

1 4 0 3

PURPOSE:

It provides techniques of writing and also trains the students to write without their influence of mother tongue. In addition to honing their skills as professional writers, students will develop technical vocabularies that will aid writing research articles and discussing articles produces by their peers.

COURSE OBJECTIVE:

- Develop abilities to write technically and expressively.
- Recognize writing as a constructive, meaningful process.
- Practise using reading strategies for effective writing.
- To develop communication skills
- Understand English grammar and usage of various phrases and idioms
- Construct simple sentences, correct common grammatical errors in written English

COURSE OUTCOMES:

Students undergoing this course are able to

- Construct simple sentences, correct common grammatical errors in written English.
- Build confidence in English language by imbibing lexical and syntax rules.
- Enrich their reading ability for effective writing.
- Read and review technical papers
- Write technical papers by their own
- face technical interviews with confidence

UNIT I BASICS OF WRITING 9

Introduction to Technical Writing – Importance of Writing – Characteristics of Writing– Audience Recognition/ Analysis – Appropriateness of language — Conciseness and Flow– Bias free and plain writing – Impersonal and Formal Language -Techniques of Technical Writing– Overcoming writer's block – Prioritizing for effective writing– Avoiding plagiarism.

UNIT II PARAGRAPHS AND ESSAYS 9

Expressing Ideas – Paragraph construction – Cohesion and Coherence – Adequate development – Kinds of paragraphs – Writing drafts – Paragraph length and pattern – Types of Essays – Characteristics of Essays – Salient point of sentence constructions.

UNIT III LETTERS, MEMOS AND EMAIL 9

Formal written correspondence – Types of messages – Business letters – Structure of letters – Language in letters – Tense in letters – Cover letters – Resumes – Curriculum vitae – Memos – Emails – Email Etiquette – Effectiveness and purpose.

UNIT IV THE ART OF CONDENSATION AND TECHNICAL PROPOSALS 9

Steps to Effective précis writing – Guidelines – Technical Proposals – Types of Proposals – Characteristics – Body of the Proposals – Style and appearance – Evaluation of proposals – Proof Reading – Book /Film Review – Travelogue – Dialogue Writing.

UNIT V REPORTS AND RESEARCH ARTICLES 9

Discussion of newspaper articles -Objectives of Reports – Characteristics of Reports – Structure of Reports – Types of Reports – Writing an article – Writing research articles – Essential features of Dissertation – Organizing the structure of thesis and articles – Writing technical description.

Total: 45

TEXTBOOK:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	V.N. Arora & Lakshmi	Improve Your Writing: Revised First Edition	OUP	2014

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1	Crème, P. and M. Lea.	Writing at University: A guide for students.	OUP	2003
2	Graham King	Collins Improve Your Writing	Collins; First edition	2009
3	David Morley	The Cambridge Intro. To Creative Writing	Cambridge	2008

WEBSITES:

1. http://www.stevepavlina.com/blog/2006/08/10-ways-to-improve-your-technical-skills/
2. http://www.nyu.edu/classes/keefer/brain/net2.html
3. https://www.udemy.com/technical-writing-and-editing/
4. http://techwhirl.com/what-is-technical-writing/

LIST OF OPEN ELECTIVES OFFERED BY
COMPUTER SCIENCE ENGINEERING DEPARTMENT

		L	T	P	C
19BECSOE01	**INTERNET PROGRAMMING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- To introduce the Java programming language and explore its current strengths and Weaknesses
- To study the way that object-oriented concepts are implemented in the Java programming language
- To write working Java code to demonstrate the use of applets for client side programming
- To study the way that exceptions are detected and handled in the Java programming language
- To write working Java code that demonstrates multiple threads of execution
- To understand about various Internet applications

COURSE OUTCOME

- Know Java programming language and explore its current strengths and Weaknesses
- Learn about object-oriented concepts
- Learn Java code to demonstrate the use of applets for client side programming
- To study the way that exceptions are detected and handled in the Java programming language
- know Java code that demonstrates multiple threads of execution
- To understand about various Internet applications

UNIT I INTRODUCTION 9

Introduction - Network of Networks, Intranet, Extranet and Internet.World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Sub netting and addressing- Classful and Classless Addressing, Sub netting

UNIT II HTML 9

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Color name, Color value. Image Maps- map,

area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

UNIT III PERL 9

Introduction, Variable, Condition, Loop, Array, implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets-Container Class, Components, Applet Life Cycle, Update method, Applications.

UNIT IV CLIENT-SERVER PROGRAMMING 9

Client-Server programming in Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks- Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

UNIT V INTERNET TELEPHONY 9

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP-Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

Total: 45

TEXTBOOKS:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Paul Deitel, Harvey Deitel and Abby Deitel	Internet and World Wide Web-How to Program 5thEdition	Dorling Kindersley pvt Ltd	2011
2.	N.P. Gopalan and J. Akilandeswari	Web Technology: A Developer's Perspective	PHI Learning	2013

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Rahul Banerjee	Internetworking Technologies, An Engineering Perspective	PHI Learning, Delhi	2011
2.	Robert W. Sebesta	Programming the World Wide Web	Pearson Education	2016

19BECSOE02 **MULTIMEDIA AND ANIMATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:

- To study the graphics techniques and algorithms
- To study the multimedia concepts and various I/O technologies.
- To enable the students to develop their creativity
- To impart the fundamental concepts of Computer Animation and Multimedia.
- To understand Techniques of Animation
- Learn about different 3D Animation

COURSE OUTCOMES:

After the course the student will be able to:

- Get Familiarised With Animation
- Types Of 3D Animation
- Know about motion caption
- Work With The Timeline And Tween-Based Animation
- Learn about 3D Animation
- Master the techniques of computer animation and multimedia

UNIT I INTRODUCTION **9**

What is mean by Animation – Why we need Animation – History of Animation– Uses of Animation – Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects -Creating Animation.

UNIT II CREATING ANIMATION IN FLASH **9**

Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-based Animation - Working with the Timeline and Tween-based Animation – Understanding Layers - Action script.

UNIT III 3D ANIMATION & ITS CONCEPTS **9**

Types of 3D Animation – Skeleton & Kinetic 3D Animation – Texturing & Lighting of 3D Animation – 3D Camera Tracking – Applications & Software of 3D Animation.

UNIT IV MOTION CAPTION **9**

Formats – Methods – Usages – Expression – Motion Capture Software's – Script Animation Usage – Different Language of Script Animation Among the Software.

UNIT V CONCEPT DEVELOPMENT **9**

Story Developing – Audio & Video – Color Model – Device Independent Color Model – Gamma and Gamma Correction - Production Budgets- 3D Animated Movies.

Total: 45

TEXTBOOK:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Malay K. Pakhira	Computer Graphics, Multimedia and Animation	PHI Learning PVT Ltd	2010

REFERENCES:

S.NO	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Ranjan Parekh	Principles of Multimedia	TMH	2007
2.	Ashok Banerji, Ananda Mohan Ghosh	Multimedia Technologies	McGraw Hill Publication	2010
3.	Pankaj Dhaka	Encyclopedia of Multimedia and Animations	Anmol Publications	2011

19BECSOE03 PC HARDWARE AND TROUBLE SHOOTING L T P C

3 0 0 3

COURSE OBJECTIVES:

- Assemble/setup and upgrade personal computer systems
- Perform installation, configuration, and upgrading of microcomputer hardware and software.
- Install/connect associated peripherals.
- Diagnose and troubleshoot microcomputer systems hardware and software, peripheral equipment.
- Know Multitasking and Multiprogramming
- Familiarise Various Types of faults

COURSE OUTCOMES

After the course student will be able to:

- Familiarise Special Peripherals.
- Know Computer Organization
- Know about Memory Space
- Familiarise Motherboard Logic
- Know Programmable LSI's
- Know about Data Recovery.

UNIT I INTRODUCTION 9

Introduction - Computer Organization – Number Systems and Codes – Memory – ALU – CU – Instruction prefetch – Interrupts – I/O Techniques – Device Controllers – Error Detection Techniques – Microprocessor – Personal Computer Concepts – Advanced System Concepts – Microcomputer Concepts – OS – Multitasking and Multiprogramming – Virtual Memory – Cache Memory – Modern PC and User.

UNIT II PERIPHERAL DEVICES 9

Introduction – Keyboard – CRT Display Monitor – Printer – Magnetic Storage Devices – FDD – HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax-Modem – CD ROM Drive – Scanner – Digital Camera – DVD – Special Peripherals.

UNIT III PC HARDWARE OVERVIEW 9

Introduction – Hardware BIOS DOS Interaction – The PC family – PC hardware – Inside the System Box – Motherboard Logic – Memory Space – Peripheral Interfaces and Controllers – Keyboard Interface – CRT Display interface – FDC – HDC.

UNIT IV INSTALLATION AND PREVENTIVE MAINTENANCE 9

Introduction – system configuration – pre installation planning – Installation practice – routine checks – PC Assembling and integration – BIOS setup – Engineering versions and compatibility – preventive maintenance – DOS – Virus – Data Recovery.

UNIT V TROUBLESHOOTING 9

Introduction – computer faults – Nature of faults – Types of faults – Diagnostic programs and tools – Microprocessor and Firmware – Programmable LSI's – Bus Faults – Faults Elimination process – Systematic Troubleshooting – Symptoms observation and analysis – fault diagnosis – fault

rectification – Troubleshooting levels – FDD, HDD, CD ROM Problems.

Total: 45

TEXTBOOK:

S.NO.	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	B. Govindarajalu	IBM PC Clones Hardware, Troubleshooting and Maintenance	TMH	2002

REFERENCES:

S.NO.	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Peter Abel, NiyazNizamuddin	IMB PC Assembly Language and Programming	Pearson Education	2007
2.	Scott Mueller	Repairing PC's	PHI	1992

19BECSOE04 **JAVA PROGRAMMING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
- Be aware of the important topics and principles of software development.
- Have the ability to write a computer program to solve specified problems.
- Be able to use the Java SDK environment to create, debug and run simple Java programs
- To understand Object oriented programming concepts

COURSE OUTCOMES:

After the course student will be able to:

- Familiar with programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java and work with 2D shapes
- Be familiar with Arrays – Strings - Packages
- Have the ability to write a computer program to solve specified problems.
- Work on Java SDK environment to create, debug and run simple Java programs
- To understand abstract classes

UNIT I INTRODUCTION TO JAVA 9

Object oriented programming concepts – objects – classes – methods and messages –abstraction and encapsulation – inheritance – abstract classes – polymorphism.- Objects and classes in Java – defining classes – methods - access specifiers – static members –constructors – finalize method

UNIT II PACKAGES 9

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – class hierarchy –polymorphism – dynamic binding – final keyword – abstract classes

UNIT III I/O STREAMS 9

The Object class – Reflection – interfaces – object cloning – inner classes – proxies - I/O Streams - Graphics programming – Frame – Components – working with 2D shapes.

UNIT IV EXCEPTION HANDLING 9

Exceptions – Syntax of exception handling code – Multiple catch statements – Using finally statements – Throwing our own exceptions – Using exceptions for debugging

UNIT V THREADS 9

Introduction, Creating Threads, The Life Cycle of a Thread, Thread Methods, Using Threads, Synchronization of Threads, Summary

Total: 45

TEXTBOOK:

S.NO.	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	Cay S. Horstmann and Gary Cornell	Core Java: Volume I - Fundamentals	Sun Microsystems Press	2008

REFERENCES:

S.NO.	Author(s) Name	Title of The Book	Publisher	Year of Publication
1.	K. Arnold and J. Gosling	The JAVA programming language Third edition	Pearson Education	2009
2.	Timothy Budd	Understanding Object-oriented programming with Java Updated Edition	Pearson Education	2002
3.	C. Thomas Wu	An introduction to Object-oriented programming with Java Fourth Edition	Tata McGraw-Hill Publishing company Ltd	2008

WEBSITES:

1. http://elvis.rowan.edu/~kay/cpp/vc6_tutorial/
2. http://www.winprog.org/tutorial/msvc.html
3. http://www.tutorialized.com/tutorials/Visual-C/1
4. http://www.freeprogrammingresources.com/visualcpp.html

LIST OF OPEN ELECTIVES OFFERED BY
ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

19BEEEOE01 ELECTRIC HYBRID VEHICLES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of electric hybrid vehicle.
- To gain the knowledge about electric propulsion unit.
- To understand and gain the knowledge about various energy storage devices.
- To know the concept of electric hybrid vehicle
- Understand the various energy storage schemes
- Know about the various fuel efficiency schemes

COURSE OUTCOMES:

- At the end of the course the student will be understand the concept of electric hybrid vehicle and its energy storage schemes.
- Battery based energy storage and its analysis,
- Familiarise Fuel Cell based energy storage and its analysis
- Super Capacitor based energy storage and its analysis,
- Understand Flywheel based energy storage and its analysis,
- Know Hybridization of different energy storage devices.

UNIT I INTRODUCTION 9

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II HYBRID ELECTRIC DRIVE-TRAINS 9

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III ELECTRIC PROPULSION UNIT 9

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motr drives, drive system efficiency.

UNIT IV ENERGY STORAGE 9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis,

Hybridization of different energy storage devices.

UNIT V ENERGY MANAGEMENT STRATEGIES 9

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Total: 45

TEXTBOOK:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Iqbal Hussein	Electric and Hybrid Vehicles: Design Fundamentals	CRC Press – 2nd edition	2010

REFERENCES:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design	Standardsmedia – 2nd edition	2009
2	James Larminie, John Lowry	Electric Vehicle Technology Explained	Wiley – 2nd edition	2012

19BEEEOE02 ENERGY MANAGEMENT AND ENERGY AUDITING L T P C
3 0 0 3

Course Objectives:

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.
- To gain the knowledge about the basic concept of types of Energy Audit
- To gain and Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- To study about the behaviour changes of PF requirement in motor currents

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the concept of Energy Management.
- Analyze the different methods for economic analysis
- Knowledge about the basic concept of Energy Audit and types.
- Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- Investigate the different methods to improve power factor.

UNIT I ENERGY MANAGEMENT 9

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting –Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.

UNIT II ECONOMIC ASPECTS AND ANALYSIS 9

Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.

UNIT III BASIC PRINCIPLES OF ENERGY AUDIT 9

Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT IV ENERGY EFFICIENT MOTORS 9

Electric Motors: Factors affecting efficiency - Energy efficient motors - constructional details, characteristics - voltage variation –over motoring – motor energy audit-

Energy conservation: Importance-energy saving measures in DG set-fans and blowers pumps- air conditioning system- energy efficient transformers.

UNIT V POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS 9

Power factor - methods of improvement, location of capacitors, p.f with non linear loads, effect of harmonics on p.f,- p.f motor controllers –Energy efficient lighting system design and practice-lighting control– Measuring Instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tong testers, application of PLCs.

Total: 45

TEXTBOOK:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Murphy W.R. and G.Mckay Butter worth	Energy Management	Heinemann Publications	2007

REFERENCES:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	John.C.Andreas	Energy Efficient Electric Motors	Marcel Dekker Inc Ltd – 3rd edition	2005
2	W.C.Turner Steve Doty	Energy Management Handbook	Lulu Enterprises, Inc. - 8th Edition Volume II	2013

19BEEEOE03 PROGRAMMABLE LOGIC CONTROLLER L T P C
3 0 0 3

Course Objectives

- To understand the basic principles of PLC systems.
- To gain the knowledge about data handling functions.
- To gain the knowledge of storage techniques in PLC
- To acquire the knowledge about how to handle the data and functions
- To study about flow charts of ladder and spray process system
- To understand the principles of PID.

Course Outcome

- At the end of the course the student will be able to understand the registers and functions in PLC and they are able to do the program.
- To acquire the knowledge of storage techniques in PLC
- Students know how to handle the data and functions
- Students known about advanced controller in PLC applications
- Students gather real time industrial application of PLC
- Students gathered and evaluate the flow charts of ladder and spray process system

UNIT I INTRODUCTION 9

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment Programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT II PLC PROGRAMMING 9

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT III REGISTERS AND PLC FUNCTIONS 9

PLC Registers: Digital logic gates programming holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT IV DATA HANDLING FUNCTIONS 9

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT V PID PRINCIPLES 9

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

Total: 45

TEXTBOOK:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	JR Hackworth and F.D Hackworth – Jr	Programmable Logic Controllers – Programming Method and Applications	Pearson	2006

REFERENCES:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	John Webb and Ronald A Reiss	Programmable Logic Controllers – Principle and Applications	Fifth edition, PHI	2004
2	W.Bolton	Programmable Logic controller	Elsevier Newnes Publications, 5th Edition	2009

WEBSITE:

1. http://www.mikroe.com/old/books/plcbook/chapter1/chapter1.htm,- Introduction to programmable Logic controller.

19BEEEOE04 RENEWABLE ENERGY RESOURCES L T P C

3 0 0 3

Course Objectives

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
- To study about solar energy collectors and its storages
- To study about the inter connected system in wind power
- To understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

Course Outcomes

At the end of this course, students will demonstrate the ability to

- Analyze the Energy Scenario in india
- Understand the concept of Solar Energy
- Understand the concept of Wind Energy
- Understand the concept of Hydro Energy
- Analyze the different energy sources
- Students gathered the real time inter connected system modelling in wind power

UNIT I INTRODUCTION 9

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2003.

UNIT II SOLAR ENERGY 9

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

UNIT III WIND ENERGY 9

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT IV HYDRO ENERGY 9

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes.Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V OTHER SOURCES 9

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

Total: 45

TEXTBOOKS:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Rai.G.D	Non-conventional sources of energy	Khanna publishers	2011
2	Khan.B.H	Non-Conventional Energy Resources	The McGraw Hills, Second edition	2009

REFERENCES:

S. NO.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Rao.S. &Parulekar	Energy Technology	Khanna publishers, Eleventh Reprint	2013
2	Godfrey Boyl	Renewable Energy: Power sustainable future	Oxford University Press, Third edition	2012
3	John W Twidell and Anthony D Weir	Renewable Energy Resources	Taylor and Francis – 3rd edition	2015

WEBSITES:

1. www.energycentral.com
2. www.catelelectricpowerinfo.com

LIST OF OPEN ELECTIVES OFFERED BY ELECTRONICS AND COMMUNICATION ENGINEERING

19BEECOE01 REAL TIME EMBEDDED SYSTEMS L T P C 100
3 0 0 3

Course Objectives

- To introduce students to the embedded systems, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To study about task management
- To learn about semaphore management and message passing
- To study about memory management
- To imparts knowledge on

Course Outcomes

At the end of the course the students will be able to

- Understand overview of embedded systems architecture
- Acquire knowledge on embedded system, its hardware and software.
- Gain knowledge on overview of Operating system
- Discuss about task Management
- Gain knowledge about semaphore management and message passing.
- Gain knowledge about memory management.

UNIT-I INTRODUCTION TO EMBEDDED SYSTEM 9

Introduction- Embedded systems description, definition, design considerations &requirements-Overview of Embedded SystemArchitecture (CISC and RISC)-Categories of Embedded Systems-embedded processor selection &tradeoffs- Embedded design life cycle -Product specifications-hardware / software partitioning- iterations and implementation- hardware software integration – product testing techniques–ARM7.

UNIT-II OPERATING SYSTEM OVERVIEW 9

Introduction–AdvantageandDisadvantageofUsingRTOS–Multitasking–Tasks-RealTimeKernels – Scheduler- Non-Preemptive Kernels – Preemptive Kernels – Reentrancy- ReentrantFunctions– Round Robin Scheduling- Task Priorities- Static Priorities– Mutual Exclusion–Deadlock– Inter task Communication–Message Mailboxes–Message Queues- Interrupts- TaskManagement– Memory Management-Time Management–Clock Ticks.

UNIT-III TASK MANAGEMENT 9

Introduction-µ C/OS-II Features-Goals ofµ C/OS-II-Hardware and Software Architecture–Kernel Structures: Tasks–Task States–Task Scheduling–Idle Task–Statistics Task–Interrupts Under µC/OS-II –Clock Tick-µ C/OS- II Initialization. Task Management: Creating Tasks–Task Stacks–

StackChecking–Task'sPriority–SuspendingTask–ResumingTask.TimeManagement: Delaying aTask–Resuming a Delayed Task–System Time. Event Control Blocks-Placing a Task in the ECB Wait List–Removing a Task from an ECB wait List.

UNIT-IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING 9

Semaphore Management: Semaphore Management Overview– Signaling a Semaphore. MessageMailbox Management: Creating a Mailbox –Deleting Mailbox–Waiting for a Message box–Sending Message to a Mailbox- Status of Mailbox. Message Queue Management: Creating Message Queue– Deleting a Message Queue–Waiting for a Message Queue–Sending Message to a Queue– Flushing a Queue.

UNIT-V MEMORY MANAGEMENT 9

Memory Management: Memory Control Blocks–Creating Partition-Obtaining a Memory Block–Returning a Memory Block. Getting Started withµ C/OS-II–Installingµ C/OS-II–Portingµ C/OS-II:Development Tools–Directories and Files– Testing a Port -IAR Workbench withµ C/OS-II-µ C/OS- II Porting on a 8051CPU– Implementation of Multitasking- Implementation of Scheduling andRescheduling –Analyze the Multichannel ADC with help ofµ C/OS-II.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	JeanJ. Labrosse	Micro C/OS–II The Real Time Kernel	CMPBOOKS	2009
2	David Seal	ARM Architecture Reference Manual.	Addison-Wesley	2008
3	Steve Furbe,	ARM System-on-Chip Architecture,	Addison-Wesley Professional, California	2000

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	K.V.K.K.Prasad	Embedded Real-Time Systems: Concepts, Design & Programming	Dream Tech Press	2005

2	Sriram V Iyer, Pankaj Gupta	Embedded Real Time Systems Programming	Tata McGraw Hill	2004

19BEECOE02 CONSUMER ELECTRONICS L T P C 100

3 0 0 3

Course Objectives

- To study about various speakers and microphone
- To learn the fundamental of television systems and standards
- To learn the process of audio recording and reproduction
- To study various telephone networks
- To discuss about the working of home appliances
- To familiarize with TV services like ISDN.

Course Outcomes

At the end of the course the students will be able to

- Understand working of various type of loud speakers
- Acquire knowledge on various types of picture tubes
- Demonstrate the working of various optical recording systems
- Distinguish various standards for color TV system
- Acquire knowledge on various telecommunication networks
- Demonstrate the working of various home appliances

UNIT I LOUDSPEAKERS AND MICROPHONES 9

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters – Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones.

UNITII TELEVISION STANDARDS AND SYSTEMS 9

Components of a TV system–interlacing–composite video signal.Colour TV– Luminance and Chrominance signal; Monochrome and Colour Picture Tubes- Color TV systems– NTSC, PAL, SECAM-Components of a Remote Control.

UNITIII OPTICAL RECORDING AND REPRODUCTION 9

Audio Disc– Processing of the Audio signal–readout from the Disc –Reconstruction of the audio signal–Video Disc–Video disc formats- recording systems–Playback Systems.

UNITIV TELECOMMUNICATION SYSTEMS 9

Telephone services-telephone networks–switching system principles–PAPX switching–Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network.Wireless Local Loop.VHF/UHF radio systems, Limited range Cordless Phones; cellular

modems.

UNITV HOME APPLIANCES 9

Basic principle and block diagram of microwave oven; washing machine hardware and software; Components of air conditioning and refrigeration systems.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	S.P. Bali	Consumer Electronics	PearsonEducation	2007
2	J.S.Chitode	Consumer Electronics	Technical Publications	2007

REFERENCE:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Philip Hoff,Philip Herbert Hoff.	Consumer Electronics for Engineers.	Cambridge University Press	1998

19BEECOE03 NEURAL NETWORKS AND ITS APPLICATIONS L T P C 100

3 0 0 3

Course Objectives

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate how to use Soft Computing to solve real-world problems
- To have a solid understanding of Basic Neural Network.
- To provide students with a sound and comprehensive understanding of artificial neural networks and machine learning.
- To gain exposure in the field of neural networks and relate the human neural system into the digital world
- To provide knowledge of computation and dynamical systems using neural networks

Course Outcomes

At the end of the course the students will be able to

- Understand the basic concepts of neural networks and its applications in various domains
- Gain knowledge about learning process in Neural Networks
- Apply perception concept in design
- Design using ART phenomena
- Gain knowledge on SOM concepts
- Ability to develop the use of Soft Computing to solve

UNIT I INTRODUCTION TONEURAL NETWORKS 9

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

UNIT II LEARNING PROCESS 9

Error– correction learning– memory based learning- hebbian learning-competitive learning-Boltzmann learning-supervised and unsupervised learning-adaptation-statistical learning theory.

UNIT III PERCEPTION 9

Single layer Perception-Adaptive filtering-unconstrained Optimization-Least-mean square algorithm- Leaning Curve-Annealing Technique-perception convergence Theorem-Relationship between perception and Baye's Classifier-Back propagation algorithm

UNIT IV ATTRACT OR NEURAL NETWORK AND ART 9

Hopfield model-BAM model -BAM Stability-Adaptive BAM -Lyapunov function-effect of gain-Hopfield Design-Application to TSP problem-ART-layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP.

UNIT V SELF ORGANIZATION 9

Self-organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical Vector Quantization. Applications of self-organizing maps: The Neural Phonetic Type Writer Learning Ballistic Arm Movements.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	SimonHaykin	Neural Networks and Learning Machines	Pearson/Prentice Hall 3rd Edition	2009
2	SatishKumar	Neural Networks: A Classroom Approach	TMH	2008

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Rajasekaran.S, VijayalakshmiPai. G.A	Neural Networks, Fuzzy Logic and Genetic Algorithms,	PHI, New Delhi.	2003
2	LaureneFausett	Fundamentals of Neural Networks: Architectures, Algorithms, and Applications	Pearson/PrenticeHall	1994
3	Wasserman P.D	Neural Computing Theory & Practice	Van Nortrand Reinhold	1989
4	Freeman J.A., S kapura D.M	Neuralnetworks, algorithms, applications, and programming techniques.	AdditionWesley	2005

19BEECOE04 FUZZY LOGIC AND ITS APPLICATIONS L T P C 100

3 0 0 3

Course Objectives

- To introduce the basic concepts of Fuzzy logic and its applications in various domain
- To educate how to use Fuzzy computation to solve real-world problems
- To have a solid understanding of Basic fuzzy models.
- Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
- To learn about applications on Fuzzy based systems
- To familiarize with fuzzy fiction and de fuzzy fiction procedures

Course Outcomes

At the end of the course the students will be able to

- Understand the basic concepts of Fuzzy logic and its applications in various domain
- Gain knowledge on theory of Reasoning
- Develop fuzzy controllers
- Understand concepts of adaptive fuzzy control
- Ability to develop how to use Fuzzy computation to solve real- world problems
- Design fuzzy based model for any application

UNITI **9**

Basics of Fuzzy Logic: Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

UNIT II **9**

Theory of Approximate Reasoning: Linguistic variables, Fuzzy proportions, Fuzzy if-then statements, inference rules, compositional rule of inference-fuzzy models

UNIT III **9**

Fuzzy Knowledge Based Controllers (Fkbc): Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzy fiction and de fuzzy fiction procedures– Design of Fuzzy
Logic Controller

UNIT IV **9**

Adaptive Fuzzy Control: Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Set organizing controller model

based controller.

UNIT V **9**

Fuzzy based systems: Simple applications of FKBC-washing machines-traffic regulations-lift control-fuzzy in medical Applications-Introduction to ANFIS.

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	D .Diankar ,H. Hellendoom and M .Rein frank	An Introduction to Fuzzy Control	Narosa Publishers India	1996
2	G.J. KlirandT.A. Folger	Fuzzy Sets Uncertainty and Information	PHI IEEE	1995

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Timothy J. Ross	Fuzzy Logic with Engineering Applications	McGraw Hill	1997
2	George. J Klir and Bo Yuan	Fuzzy Sets and Fuzzy Logic	Prentice Hall, USA	1995

LIST OF OPEN ELECTIVES OFFERED BY BIO TECHNOLOGY DEPARTMENT

19BTBTOE01 **BIOREACTOR DESIGN** **L T P C**
3003

COURSE OBJECTIVES:

- To understand the basic design of bioreactors
- To understand the principle of heat transfer inside a bioreactor
- Design of various reactors
- Study various mass transfer equipments
- Learn about cylindrical storage tnks and various applications
- Design of plate and frame filters

COURSE OUTCOMES:

After completion of this course students will be able to

- Design bioreactors for various operations.
- Select the appropriate separation equipment based on the nature of the product.
- Familiarise mass transfer equipments
- Work with cylindrical storage tnaks and know various applications
- Design of plate and frame filters in reactors
- Know varius separation equipments

UNIT I ENGINEERING PROPERTIES AND STORAGE TANK **9**

Introductiontovariousmechanicalpropertiesofmaterialtobeusedmaterialofconstruction, designofcylindricalstoragetank.

UNIT II REACTOR DESIGN **9**

DesignofAirliftfermentor,BubblecolumnreactorandContinuousstirredtankreactor.

UNIT III HEAT TRANSFER EQUIPMENTS **9**

DesignofShellandtubeHeatexchanger,Doublepipeheatexchanger,longtube verticalevaporatorandforcedcirculation evaporator.

UNIT IV MASS TRANSFER EQUIPMENTS **9**

DesignofBollmannextractor,fractionatingcolumn,packedtowerandspraytrayabsorber

UNIT V SEPARATIONEQUIPMENTS **9**

Designof plate andframefilter press,leaffilter,rotarydrumfilter,discbowlcentrifuge, rotary drumdrierandSwenson–walkercrystallizer.

Total:45

TEXTBOOKS:

S.NO.	Author(s)Name	Titleofthebook	Publisher	YearofPublicatio
1	James Edwin Bailey, DavidF.Ollis	Biochemical Engineering Fundamentals	McGraw-Hill	2007
2	DonW.Green,RobertH.Perry	Chemical Engineer Handbook	The McGraw-HillCompanies, Inc.	2008

REFERENCE:

S.NO	Author(s)Name	Titleofthebook	Publisher	Year of Publications
1	Pauline.M.Doran	BioprocessEngineering Principles	Academic Press	2013

19BTBTOE02 FOOD PROCESSING AND PRESERVATION L T P C

3003

OBJECTIVES:

- To understand the importance of food processing
- To make the students learn the various processing and preservation techniques.
- Understand various Pasteurization and Freezing techniques
- Learn about Infrared radiation processing-
- Concepts ande quipment used. In various food processing methods
- Learn about preservation of fruits and vegetables

INTENDED OUTCOMES:

The students are exposed to

- Properties off Food material.
- Various methods used for preserving Fruits and vegetables
- Learn about chemical preservation
- Know food preservation by cooling methods
- Learn about Food irradiation
- Understand fermentation techniques

UNIT I SCOPE AND IMPORTANCE OF FOOD PROCESSING 9

Properties of food- Physical, thermal, mechanical, sensory.Raw material Preparation - Cleaning,sorting,grading,peeling.

UNIT II PROCESSING METHODS 9

Heating- Blanching and Pasteurization.Freezing- Dehydration- canning- additives- fermentation- extrusion cooking- hydrostatic pressure cooking- dielectric heating- microwave processingandasepticprocessing–Infraredradiationprocessing- Conceptsandequipmentused.

UNIT III FOOD CONVERSION OPERATIONS 9

Size reduction- Fibrous foods, dry foods and liquid foods- Theory and equipments- membrane separation-filtration-equipmentandapplication.

UNITIV FOODPRESERVATION BY COOLING 9

Refrigeration, Freezing-Theory, freezing time calculation, methods of freezing, freezing equipments, freeze drying, freeze concentration, thawing, effect of low temperature on food. Wateractivity, methods tocontrolwateractivity.

UNITV PRESERVATIONMETHODSFORFRUITSANDVEGETABLES 9

Preprocessing operations - preservation by reduction of water content: drying / dehydration and concentration – chemical preservation – preservation of vegetables by acidification, preservation with sugar - Heat preservation– Food irradiation- Combined preservation techniques.

Total: 45

TEXTBOOKS:

S.NO	Author(s)Name	Titleofthebook	Publisher	Year of Publication
1	R.PaulSingh, DennisR.Heldman	Introduction to food engineering.	Academic Press	2001
2	P.Fellows.	FoodProcessing Technology, Principles and practice.	Woodhead Publishing Ltd	2000
3	MirceaEnachescuDauthy	Fruit and Vegetable Processing	FAOagricultural services bulletin no.119	1995

REFERENCES:

S.NO	Author(s)Name	Titleofthebook	Publisher	Yearof Publications
1	M.A. Rao, Syed S.H. Rizvi,AshimK.Datta	Engineering properties Offoods	CRCPress	2005
2	B.Sivasankar	Food processing and preservation	PHILearning Pvt. Ltd	2002

19BTBTOE03 BASIC BIOINFORMATICS L T P C 3 0 0 3

COURSE OBJECTIVES:

- To enablethestudentsto get awareof availabletools anddatabasesfor performingresearchinbioinformatics.
- To provide the thorough understanding of protein structure in detail.
- bioinformatics at a level appropriate for biology majors having completed the lower-division core, and for chemistry, computer science, and math majors with an interest in biology.
- the chemical principles that underlie biochemistry, molecular biology and genomics,
- the design and implementation of relational databases
- the construction of predictive mathematical models of biological systems.

COURSE OUTCOMES:

At the end of the course,

- The students will understand the importance of Bioinformatics in various sectors.
- The students will be exposed to biological database management and microarray technology.
- Understand advanced methods in computational biology
- Be capable of **using critical thinking and research methods in Bioinformatics** to understand computational and experimental data
- Demonstrate the ability to **produce and present original research in Bioinformatics**.
- preparation for and presentations at scientific meetings, and graduate seminars, student seminars, and qualifying examinations.

UNIT I OVERVIEW OF BIOINFORMATICS 9

Thescopeofbioinformatics; bioinformatics&theinternet;usefulbioinformatics sites.Data acquisition:sequencingDNA,RNA&proteins;determination ofproteinstructure;gene&protein expression data;proteininteractiondata. Databases–contents,structure&annotation:fileformats; annotatedsequencedatabases;miscellaneousdatabases.

UNITII RETRIEVALOFBIOLOGICALDATA 9

DataretrievalwithEntrez&DBGET/LinkDB;dataretrievalwithSRS(sequence retrieval system).Searching sequencedatabasesbysequencesimilaritycriteria:sequencesimilarity searches;aminoacidsubstitution matrices;databasesearches,FASTA&BLAST;sequence filters;iterativedatabasesearches&PSI-BLAST.Multiple-sequence alignment,gene&protein families:multiple-sequence alignment&family relationships;proteinfamilies&pattern databases;proteindomainfamilies.

UNITIII PHYLOGENETICS 9

Phylogenetics, cladistics &ontology; building phylogenetic trees; evolution of macromolecularsequences.Sequenceannotation:principlesofgenomeannotation;annotationtools &resources.

UNITIV STRUCTURALBIOINFORMATICS 9

Conceptualmodelsofproteinstructure;therelationshipofproteinthree-dimensional structureto proteinfunction;theevolutionofproteinstructure&function;obtaining, viewing&analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure:CATH&SCOP;introduction toproteinstructureprediction;structurepredictionby comparativemodeling;secondary structureprediction;advancedproteinstructureprediction& predictionstrategies.

UNITV MICROARRAYDATAANALYSIS 9

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics &drug discovery; pharmainformaticsresources.Basicprinciplesof computinginbioinformatics:running computer software; computer operating systems;softwaredownloading &installation;database management.

Total: 45

TEXTBOOKS:

S.NO.	Author (s) Name	Titleof thebook	Publisher	Year of Publication
1	Dan E. Krane, Michael Rayme	Fundamental Concepts ofBioinformatics	Pearsoneducation	2004
2	Andreas D. Baxevanis, F. Francis Ouellette	Bioinformatics: A PracticalGuidetotheAnalysisof Genes andProteins	Wiley-Interscience	2004
3	David W. Mount	SequenceandGenomeAnalysis	ColdSpringHarbor Laboratory	2004
4	Jonathan Pevsner	Bioinformatics and FunctionalGenomics	Wiley-Liss	2003

REFERENCEBOOK:

S.NO.	Author (s) Nam	Titleof thebook	Publisher	Year of Publication
1	Michael J. Korenberg	Microarray Data Analysis: MethodsandApplications	Springer Science & BusinessMedia	2007

19BTBTOE04 FUNDAMENTALS OF NANOBIOTECHNOLOGY L T P C 3003

COURSE OBJECTIVES:

- To develop skills of the students in the field of nano biotechnology and its applications in various fields.
- The course will serve as an effective course to understand Socio-economic issues of Nanobiotechnology.
- Scope of nanaoparticles in biomedical field
- Ethical issues working with nanoparticles
- Learn about nanosurgical devices
- BenefitsandchallengesinMolecularmanufacturing:

COURSE OUTCOMES:

At the end of the course,

- The students will be able to identify the potential areas where nanoparticles can be utilized.
- The students will be exposed to the ethical issues regarding the use of nanoparticles.
- Learn Techniques to Synthesize Nanoparticles
- Learn about nanosurgical devices
- Familiarise MEMS/NEMS
- Know about various lithographic techniques

UNITI INTRODUCTION (9)

Introduction, ScopeandOverview,Lengthscales,Importance ofNanoscaleandTechnology, HistoryofNanotechnology, FutureofNanotechnology:NanoTechnologyRevolution,Silicon basedTechnology,BenefitsandchallengesinMolecularmanufacturing: TheMolecular assemblerconcept,Controversiesandconfusions,Understanding advancedcapabilities, NanotechnologyinDifferent,Fields:Nanobiotechnology,Materials,Medicine,Dentalcare.

UNITII NANOPARTICLES (9)

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, CharacterizationofNanoparticles, Applications,ToxiceffectsofNanomaterials, Significance ofNanoparticlesNanofabrications-MEMS/NEMS,Atomic ForceMicroscopy,Selfassembled monolayers/Dip-penNanolithography, SoftLithography, PDMSMolding,NanoParticles, Nanowires andNanotubes.

UNITIII APPLICATIONS (9)

Nanomedicine,NanobiocensorandNanofludics.Nanocrystals inbiological detection, ElectrochemicalDNAsensors and IntegratedNanolitersystems.Nano-Biodevicesand Systems.Fabricationof Novel Biomaterialsthrough molecularself assembly- Small scale systemsforinvivodrugdelivery- Futurenanomachine.

UNITIV NANOBIOTECHNOLOGY (9)

Clinicalapplicationsofnanodevices.Artificialneurons.Real-timenanosensors-Applicationsin cancerbiology.Nanomedicine.Syntheticretinyl chipsbasedonbacteriorhodopsins.High throughputDNAsequencingwithnanocarbontubules.Nanosurgicaldevices.

UNITV ETHICALISSUESINNANOTECHNOLOGY (9)

Introduction,Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, NanomedicineAppliedinNonmedicalContexts,SocialIssues RelatingtoNanomedicine. SocialandEthicalIssues,EconomicImpacts,OtherIssues, Nanotechnologyand FutureSocio-economicchallenges.

Total: 45

TEXTBOOKS:

S.NO.	Author (s) Name	Titleof thebook	Publisher	Year of Publication
1	Niemeyer,C.M. andMirkin,C.A	Nanobiotechnology:Con cepts, Applicationsand	Wiley-VCH	2004
2	Goodsell,D.S.	Bionanotechnology	JohnWiley andSons, Inc	2004

REFERENCES:

S.No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Shoseyov,O. and Levy,I	Nanobiotechnology: BioinspiredDevicesand Materialsof theFuture	Humana Press	2007
2	Bhushan,B.	SpringerHandbookof Nanotechnology	Springer-VerlagBerlin Heidelberg	2004
3	FreitasJrR.A	Nanomedicine	Landes Biosciences	2004
4	Kohler,M.and Fritzsche,W.	Nanotechnology–An IntroductiontoNanostructuring Techniques	Wiley-VCH	2004

LIST OF OPEN ELECTIVES OFFERED BY MECHANICAL ENGINEERING DEPARTMENT

19BEMEOE01 COMPUTER AIDED DESIGN L T P C
3 0 0 3

Course Objective

- To apply basic concepts to develop construction (drawing) techniques.
- To ability to manipulate drawings through editing and plotting techniques.
- To understand geometric construction and Produce template drawings.
- To understand and demonstrate dimensioning concepts and techniques.
- To understand Section and Auxiliary Views.
- To become familiar with Solid Modelling concepts and techniques.

Course Outcome

- Apply basic concepts to develop construction (drawing) techniques.
- Ability to manipulate drawings through editing and plotting techniques.
- Understand geometric construction and Produce template drawings.
- Understand and demonstrate dimensioning concepts and techniques
- Understand Section and Auxiliary Views
- Become familiar with Solid Modelling concepts and techniques.

UNIT I OVERVIEW OF CAD SYSTEMS 9

Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNIT II INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS 9

Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transpformations, Visual Realism, Computer animation, customizing graphics software.

UNIT III GEOMETRIC MODELING 9

Wireframe, surface, NURBS and solid modeling-applications and advantages. Creating primitive solids, sweeping solids, boolean operations. Extracting entities from a solid. Filleting of edges of

solids. Boundary representation (B-rep) Constructive Solid Geometry(CSG) and Analytical Solid Modeling(ASM)

UNIT IV PARAMETRIC DESIGN AND OBJECT REPRESENTATION 9

Types of co-ordinate systems. Parametric design - definition and advantages. Parametric representation of analytic and synthetic curves. Parametric representation of surfaces and solids - manipulations.

UNIT V PRODUCT DESIGN AND DEVELOPMENT 9

Automated 2D drafting - basics, mechanical assembly - bill of materials generation. Mass property calculations.

Total: 45

TEXTBOOKS:

S. NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Vera B Anand	Computer Graphics and Geometric Modeling for Engineers	John Wiley & Sons, New York	2000
2	Radhakrishnan P and Subramanyan S	CAD/CAM/CIM	New Age International Pvt. Ltd	2004

REFERENCES:

S. NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Radhakrishnan P and Kothandaraman C P	Computer Graphics and Design	DhanpatRai& Sons, New Delhi	2002
2	Ibrahim Zeid	CAD/CAM Theory and Practice	McGraw Hill Inc., New York	2003
3	Barry Hawhes	The CAD/CAM Process	Pitman Publishing, London	1998
4	William M Newman and Robert Sproul	Principles of Interactive Computer Graphics	McGraw Hill Inc., New York	1994
5	Sadhu Singh	Computer-Aided Design and Manufacturing	Khanna Publishers, New Delhi	1998
6	Rao S S	Optimisaiton Techniques	Wiley Eastern, New Delhi	2003

19BEMEOE02 INDUSTRIAL SAFETY AND ENVIRONMENT L T P C
3 0 0 3

Course Objective

- To recognize and evaluate occupational safety and health hazards in the workplace.
- To determine appropriate hazard controls following the hierarchy of controls.
- To analyse the effects of workplace exposures, injuries and illnesses, fatalities.
- To prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
- To teach student the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
- To prevent or mitigate harm or damage to people, property, or the environment.

Course Outcome

- Recognize and evaluate occupational safety and health hazards in the workplace.
- Determine appropriate hazard controls following the hierarchy of controls.
- Analyse the effects of workplace exposures, injuries and illnesses, fatalities.
- Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
- Understand the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
- Prevent or mitigate harm or damage to people, property, or the environment

UNIT I INTRODUCTION TO LOGISTICS 9

Logistics - concepts, definitions and approaches, factors influencing logistics - Supply chain: basic tasks, definitions and approaches, influencing supply chain - a new corporate model.

UNIT II PHASES OF SUPPLY CHAIN 9

The new paradigm shift - The modular company - The network relations - Supply processes - Procurement processes - Distribution management.

UNIT III EVOLUTION OF SUPPLY CHAIN MODELS 9

Strategy and structure - Factors of supply chain - Manufacturing strategy stages - Supply chain progress - Model for competing through supply chain management - PLC grid, supply chain redesign - Linking supply chain with customer.

UNIT IV SUPPLY CHAIN ACTIVITIES 9

Structuring the SC, SC and new products, functional roles in SC - SC design frame- work - Collaborative product commerce (CPC).

UNIT V SCM ORGANISATION AND INFORMATION SYSTEM 9

The management task - Logistics organization - The logistics information systems - Topology of SC application - Product Data Management - Warehouse management system MRP- I, MRP - II, ERP,. - Case study, ERP Software's

Total: 45

TEXTBOOKS:

S. NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Shari.P.B and Lassen.T.S	Managing the global supply chain	Viva books, New Delhi	2000
2	Ayers.J.B	Hand book of supply chain management	The St. Lencie press	2000

REFERENCES:

S. NO.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Nicolas.J.N	Competitive manufacturing management - continuous improvement, Lean production, customer focused quality	McGrawHill, New York	1998
2	Steudel.H.J and Desruelle.P	Manufacturing in the nineteen - How to become a mean, lean and world class competitor	Van No strand Reinhold, New York	1992

19BEMEOE03 TRANSPORT PHENOMENA L T P C
3 0 0 3

Course Objective

- To generalized equations for mass, momentum and heat.
- To understand the concepts of Reynolds and Gauss theorems.
- To learn combined diffusive and convective transport.
- To apply Film- and penetration models for mass and heat transfer.
- To apply Stefan-Maxwells equations for multi-component diffusion.
- To Solve the given set of equations either analytically or numerically.

Course Outcome

- Generalized equations for mass, momentum and heat.
- Understand the concepts of Reynolds and Gauss theorems.
- Learn combined diffusive and convective transport.
- Apply Film- and penetration models for mass and heat transfer.
- Apply Stefan-Maxwells equations for multi-component diffusion.
- Solve the given set of equations either analytically or numerically.

UNIT I INTRODUCTION AND BASIC CONCEPTS 9

General overview of transport phenomena including various applications, Transport of momentum, heat and mass , Transport mechanism, Level of transport, Driving forces, Molecular transport (diffusion), convective transport (microscopic)

UNIT II PROPERTIES, UNITS AND OTHER PHYSICAL PARAMETERS 9

Unit systems, temperature, mole, concentration, pressure, Gas laws, laws of conservation, energy and heat units

UNIT III MOMENTUM TRANSPORT 9

Basic concepts in fluid mechanics, Force, unit and dimensions, pressure in fluid, head of fluid, Molecular transport for momentum, heat and mass transfer, Viscosity of fluids, Newton's law, Momentum transfer, Newtonian and non- Newtonian fluids, Fluid flow and Reynolds number, Overall mass balance, Control volume and Continuity equation, Overall energy balance, Bernoulli's equation, Overall momentum balance, Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidized bed

UNIT IV ENERGY TRANSPORT 9

Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, thermal conductivity, convective heat transfer coefficient, Conduction heat transfer - through flat slab/wall and through hollow cylinder, Conduction through solids in series, Forced convection heat transfer

inside pipes, Heat transfer outside various geometrics in forced convection, General discussion on natural convection heat transfer, Heat exchangers, General discussion on radiation heat transfer

UNIT V MASS TRANSPORT 9

Basic concepts in mass transport, Some application examples, Modes of mass transfer, Molecular diffusion- Fick's law, Analogy between mass, heat and momentum transfer, Dispersion, Hydraulic or Darcy's flow in porous media, Chemical kinetics and activation energy, Film theory, Convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transport, Gas-liquid mass transfer, Aeration and oxygen transport, Air stripping

Total: 45

REFERENCE:

S. NO	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Geankoplis, C. J	Transport Processes and Separation Processes Principles	Prentice Hall	2003

WEB REFERENCE:

1. https://laulima.hawaii.edu/portal

19BEMEOE04 INTRODUCTION TO BIOMECHANICS L T P C 3 0 0 3

Course Objective

- To describe the principles of the study of human movement.
- To describe the range of factors that influence the initiation, production and control of human movement.
- To identify the body's lever systems and their relationship to basic joint movement and classification.
- To distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
- To explain joint and muscle function and the forces acting upon the human body during various sporting activities.
- To relate the different body systems necessary for human movement to occur.

Course Outcome

- Describe the principles of the study of human movement.
- Describe the range of factors that influence the initiation, production and control of human movement.
- Identify the body's lever systems and their relationship to basic joint movement and classification.
- Distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
- Explain joint and muscle function and the forces acting upon the human body during various sporting activities.
- Relate the different body systems necessary for human movement to occur.

UNIT I INTRODUCTION 9

Biomechanics - Improving Performance – Applications - Preventing And Treating Injury - Qualitative And Quantitative Analysis - Scholarly Societies - Computer Searches – Biomechanical Knowledge versus Information - Kinds of Sources - Evaluating Sources

UNIT II KEY MECHANICAL CONCEPTS 9

Mechanics - Basic Units - Nine Fundamentals of Biomechanics - Principles and Laws - Nine Principles for Application ofBiomechanics

UNIT III HUMAN ANATOMY AND SOME BASIC TERMINOLOGY 9

Gross (Whole-Body) Modeling - Position and Direction Terminology - Terminology for Common Movements - Skeletal Anatomy - Major Joints - Major Muscle Groups - Anthropometric Data

UNIT IV ANATOMICAL DESCRIPTION 9

Key Anatomical Concepts - Directional Terms - Joint Motions - Muscle Actions - Active and Passive Tension of Muscle - Limitations of Functional Anatomical Analysis - Mechanical Method of Muscle Action Analysis - The Need for Biomechanics to Understand Muscle Actions - Sports Medicine and Rehabilitation Applications

UNIT V MECHANICS OF THE MUSCULOSKELETAL SYSTEM 9

Tissue Loads - Response of Tissues To Forces - Biomechanics of The Passive Muscle–Tendon Unit - Biomechanics of Bone - Biomechanics of Ligaments - Three Mechanical Characteristics of Muscle - Stretch-Shortening Cycle (SSC) - Force–Time Principle - Neuromuscular Control

Total: 45

REFERENCES:

S. NO	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Duane Knudson	Fundamentals of Biomechanics	Springer Science+ Business Media, LLC	2007
2	C. Ross Ethier Craig A. Simmons	Introductory Biomechanics	Cambridge University Press	2007

LIST OF OPEN ELECTIVES OFFERED BY AEROSPACE ENGINEERING DEPARTMENT

19BTAROE01 NON-DESTRUCTIVE TESTING L T P C
3 0 0 3

Course Objectives:

- To provide knowledge on the basic principles of NDT.
- To develop a basic knowledge about various NDT techniques.
- To learn the different NDT process parameters.
- To familiarise with internal flaws.
- To provide knowledge on common defects in manufacturing process
- To provide knowledge on standards and specifications

Course Outcomes:

Upon successful completion of the course, the students should be able to:

- Understand the basic principles of various NDT methods, fundamentals, importance of NDT
- Explain the appropriate NDT technique as per requirement.
- Knowledge to set various process parameters and control the NDT process for the desired output parameters.
- The student shall be able to find the internal flaws in the material by NDT and take measures to eliminate them.
- Ablitliy to solve various problems encountered like leakage, cracks, blowholes etc with the manufacturing process by analyzing the data.
- Describe the standards and specifications related to non-destructive testing technology.

UNIT I INTRODUCTION 9

Properties of Materials – Characteristics of Ferrous, Non-ferrous and Alloys.Destructive testing and Non-destructive testing – Classification – Uses and applications. Codes, Standards and Specifications(ASME, ASTM, AWS etc.).

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION 9

Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - An Illustration of Penetrant Testing, Advantages of Penetrant Testing, Disadvantages of Penetrant Testing. Introduction to Magnetic Particle Inspection - An Illustration of Magnetic Particle Inspection, Advantages of Magnetic Particle Crack Detection, Disadvantages of Magnetic Particle Crack Detection

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION 9

Introduction to Ultrasonic Flaw Detection ,An Illustration of Ultrasonic Flaw Detection , Advantages of Ultrasonic Flaw Detection, Disadvantages of Ultrasonic Flaw Detection, Principle of Radiography Inspection, Radiation sources, Attenuation in the specimen, Radiographic imaging, Inspection Techniques, Application and limitations, Safety.

UNIT IV EDDY CURRENT AND ELECTRO-MAGNETIC METHODS 9

Introduction to Eddy Current Testing. An Illustration of Eddy Current Testing Equipment , Advantages of Eddy Current Testing, Disadvantages of Eddy Current Testing

UNIT V NON-DESTRUCTIVE INSPECTION(NDI) AND ITS APPLICATIONS 9

Inspection of Raw Products, Inspection For In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Aircraft Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

Total: 45

TEXTBOOKS:

S.NO.	Author(s)	Title of the book	Publisher	Year of publication
1.	Louis Cartz	Nondestructive Testing	ASM International, Almere, Netherland	1995
2.	Paul E. Mix	Introduction to Nondestructive Testing	John Wiley &Sons,Newyork.	2005

REFERENCES:

S.NO.	Author(s)	Title of the book	Publisher	Year of publication
1.	Baldev Raj, T. Jayakumar, M. Thavasimuthu	Practical Non-destructive Testing	Wood head Publishing, Cambridge.	2007
2.	J. Blitz, G. Simpson	Ultrasonic Methods of Non-destructive Testing	Springer Science & Business Media	1996

WEB REFERENCE:

1. https://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT
2. https://www.asnt.org/
3. www.bindt.org/
4. www.ndt.net/
5. www.aindt.com.au/

19BTAROE02 UNMANNED AERIAL VEHICLE SYSTEMS L T P C 3 0 0 3

Course Objectives:

- To understand the UAV system design development and integration.
- To know about avionics subsystem and analyse the performance of the sub-system
- To learn the different avionics hardware used in UAV.
- To familiarise with communication and payloads.
- To provide knowledge on UAV controls.
- To impart knowledge on development of UAV systems.

Course Outcomes:

Upon successful completion of the course, the students should be able to:

- Demonstrate ability to identify and explain the complete system for UAV requirement and performance and their functions.
- Understand the UAV sub-system and input/output device & power requirement system and ability to analyze the performance of the sub-system.
- Explain the different avionics hardware used in UAV.
- Describe the communication and payloads
- Understand the concept of UAV controls
- Demonstrate the design process of UAV

UNIT I INTRODUCTION TO UAV 9

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications

UNIT II THE DESIGN OF UAV SYSTEMS 9

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations-Characteristics of Aircraft Types-Design Standards and Regulatory Aspects-UK,USA and Europe-Design for Stealth--control surfaces-specifications.

UNIT III AVIONICS HARDWARE 9

Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration, and testing

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS 9

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

UNIT V THE DEVELOPMENT OF UAV SYSTEMS 9

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing-Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Re1 Austin	Unmanned Aircraft Systems UAV design, development and deployment	John Wiley & Sons New York	2011
2.	Jay Gundlach	Designing Unmanned Aircraft Systems	American Institute of Aeronautics and Astronautics,Reston	2014
3.	Robert C. Nelson	Flight Stability and Automatic Control	McGraw-Hill, Inc New York	2004

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Douglas M Marshall, J D Richard, K Barnhart Eric Shappee ,Barnhart Marshall Shappee	Introduction to Unmanned Aircraft Systems	Taylor & Francis Ltd, Abingdon	2011
2.	Paul G Fahlstrom, Thomas J Gleason,	Introduction to UAV Systems	UAV Systems Inc	1998
3.	Dr. Armand J. Chaput	Design of Unmanned Air Vehicle Systems	Lockheed Martin Aeronautics Company, Newjersey.	2001

WEB REFERENCE:

1. www.draganfly.com/.../introduction-to-unmanned-aerial-vehicles-uavs/ rahauav.com/Library/.../Unmanned-Air-Systems
2. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-83x spaceflight.nasa.gov/shuttle/reference/shutref/orbiter/.../plcomm.html
3. www.theuav.com/

19BTAROE03 AIR TRANSPORTATION AND AERODROME DESIGN L T P C
3 0 0 3

Course Objectives:

- Apply knowledge and skills in the aviation industry and make more effective decisions for organization.
- Provide insight into current trends and issues in civil aviation, such as aviation safety and security, law and new technology.
- Understand complexity of air transport operation and to find best solution for the issues.
- Understand Various Air transport issues
- Detail the services needed to operate the aerodrome
- Identify solutions to challenges presented regarding aerodrome design and operations

Course Outcomes:

Upon successful completion of the course, the students should be able to:

- Explain the roles of the International Civil Aviation Organization and the International Air Transport Association in fostering safe and efficient air transport
- Describes national and international rules and regulations for air transportation
- Identify organizations controlling the regulatory processes in international aviation
- Describe the Various transport issues involved in handling passengers, freight of aircraft
- Demonstrate the services needed to operate the aerodrome
- Critically analyse and discuss challenges in aerodrome design and operations

UNIT I INTRODUCTION 9

Development of air transportation, comparison with other modes of transport – Role of IATA, ICAO – The general aviation industry airline – Factors affecting general aviation, use of aircraft, airport: airline management and organization – levels of management, functions of management, Principles of organization planning the organization – chart, staff departments & line departments.

UNIT II AIRLINE ECONOMICS 9

Forecasting – Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. – Passenger fare and tariffs – Influence of geographical, economic & political factors on routes and route selection.

FLEET PLANNING: The aircraft selection process – Fleet commonality, factors affecting choice of fleet, route selection and Capitol acquisition – Valuation & Depreciation – Budgeting, Cost planning – Aircrew evaluation – Route analysis – Aircraft evaluation.

UNIT III PRINCIPLES OF AIRLINES SCHEDULING 9

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule – hub & spoke scheduling, advantages / disadvantages & preparing flight plans – Aircraft scheduling in line with aircraft maintenance practices.

UNIT IV AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION 9

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

UNIT V VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES 9

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

Total: 45

TEXTBOOKS:

S.NO.	Author(s)	Title of the book	Publisher	Year of publication
1.	Robert M. Kane	Air Transportation	Kendall Hunt Publishing Company, Dubuque	2012
2.	International Civil Aviation Organization	Aerodrome Design Manual	International Civil Aviation Organization, Montreal	2006

REFERENCES:

S.NO.	Author(s)	Title of the book	Publisher	Year of publication
1.	Wilson & Bryon	Air Transportation	English Book house. New Delhi	1998
2.	AntonínKazda, Robert E. Caves	Airport Design and Operation	Emerald Group Publishing, Illovo	2015

WEB REFERENCE:

1. www.grc.nasa.gov/WWW/k-12/airplane/
2. www.scribd.com/doc/10652418/Evolution-of-Modern-Aircraft

3. www.history.navy.mil/branches/car-toc.html
4. www.britannica.com/EBchecked/topic/.../Aircraft-configurations
5. www.brown.edu/Departments/EEB/EML/.../principles_flight.html

19BTAROE04 **AVIONICS** **L T P C**
3 0 0 3

Course Objectives:

- To impart knowledge on Avionic subsystems and its design
- To familiarize the students to understand Avionics Architecture
- To study the features of various display systems
- To give exposure to navigation and flight control systems.
- To provide an overview of air data systems.
- To acquaint the student with the concepts of auto pilot system

Course Outcomes:

Upon successful completion of the course, the students should be able to:

- Enumerate the various Avionic subsystems and its design.
- Design the System architecture for various databases and explain its application in aviation.
- Identify the components and illustrate the working principles of various display systems in flight deck .
- Describe the navigation and flight control systems.
- Describe the air data systems
- Understand the concepts of auto pilot system.

UNIT I INTRODUCTION TO AVIONICS

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE

Avionics system architecture–8085 Architecture and 8086 Architecture -Bus Structure of 8085 Architecture and 8086 Architecture– data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT III FLIGHT DECKS AND COCKPITS

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT V AIR DATA SYSTEMS AND AUTO PILOT

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Albert Helfrick.D	Principles of Avionics	Avionics Communications Inc	2009
2.	R. P. G. Collinson	Introduction to Avionics Systems	Springer-Verlag, New York.	2011

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Ian Moir, Allan Seabridge, Malcolm Jukes	Civil Avionics Systems	John Wiley &Sons,New Jersey, USA.	2013
2.	Spitzer, C.R.	Avionics: Elements, Software and Functions	CRC Press Florida, USA.	2006
3.	Brain Kendal Spitzer, C.R.	Digital Avionics Handbook	CRC Press Florida, USA.	2014

WEB REFERENCES:

1. www.ntps.edu/courses/116-introduction-to-avionics-systems-course
2. www.ece.ucsb.edu/courses/ECE152/152A_Su11Shynk/Lec1.pdf
3. www.davi.ws/avionics/TheAvionicsHandbook_Cap_20.pdf
4. www.pbase.com/bruceleibowitz/cockpit
5. www.cranfield.ac.uk/soe/shortcourses/.../avionics-introduction.html

LIST OF OPEN ELECTIVES OFFERED BY AUTOMOBILE ENGINEERING DEPARTMENT

19BEAEOE01 AUTOMOBILE ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the constructional details and principle of operation of various automobile components.
- To learn the function and working of various components in transmission and drive lines.
- To study the concept and working of steering and suspension systems in an automobile.
- To give knowledge on the wheels, tyres and brakes of automobiles.
- To provide information on the current and future trends in automobiles.
- Identify and explain the types of steering system..

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

- Demonstrate the operating principles and constructional details of various automobile components.
- Explain the function and working of components in transmission and drive lines.
- Identify and explain the types of steering system.
- Identify and explain the types of suspension system.
- Classify and describe the types of wheels, tyres and brakes of automobiles.
- Discuss the current and future trends in the automobiles

UNIT I ENGINE AND FUEL FEED SYSTEMS 9

Classification of Engine, construction and working of four stroke petrol and diesel engine, firing order and its significance. Carburetor working principle, requirements of an automotive carburetor, Petrol injection Systems (MPFI, TBI), Diesel fuel injection systems (CRDI)

UNITII TRANSMISSION SYSTEMS 9

Requirements of transmission system.Flywheel. Different types of clutches, principle, Construction, torque capacity and design aspects. Objective of the gearbox - Determination of gear ratios for vehicles.Performance characteristics at different speeds. Different types of gearboxes - operation. Function of Propeller Shaft Construction details of multi drive axle vehicles. Different types of final drive. Differential principles. Constructional details of differential unit. Non-slip differential. Differential lock

UNITIII SUSPENSION SYSTEM 9

Need of suspension system - Types of suspension - Suspension springs - Constructional details and characteristics of leaf, coil and torsion bar springs - Independent suspension - Rubber suspension – Pneumatic suspension – Hydro Elastic suspension - Shock absorbers. Vibration and driving comfort.

UNITIV BRAKES 9

Necessity of brake, stopping distance and time, brake efficiency, weight transfer, shoe brake and disc brake theory, Brake actuating systems - Mechanical, Hydraulic and Pneumatic. Parking and engine exhaust brakes. Power and power assisted brakes. Antilock Braking System (ABS).

UNITV ELECTRICAL SYSTEM 9

Principle and construction of lead acid battery. Lighting system: details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator. Starting System and charging system.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Young U.P and Griffiths L	Automotive Electrical Equipment	ELBS & New Press	1999
2.	Ganesan.V	Internal Combustion Engines	Tata McGraw-Hill Publishing Co., New Delhi	2003

3.	Dr.Kirpal Singh	Automobile Engineering	Standard Publishes	2011

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Heldt .P.M	The Automotive Chassis	Literary Licensing,LLC	2012
2.	Crouse.W.H	Automobile Electrical Equipment", 3rd Edition	McGraw-Hill Book Co., Inc., New York.	1986
3.	N.Newton, W. Steeds and T.K.Garrett	The Motor vehicle, 13th edition	SAEInc	2001

19BEAEOE02 BASICS OF TWO AND THREE WHEELERS L T P C
3 0 0 3

COURSE OBJECTIVES

- The objective of this course is to make the students to know and understand the constructional details, operating characteristics and design aspects of Two and Three wheelers.
- Construct the frames of two and three wheelers of different layouts.
- Demonstrate the constructional details and principle of operation of various engine components.
- Identify and explain the types of transmission systems.
- Identify and explain the types of steering and suspension systems.
- Classify and describe the types of wheels, tyres and brakes for two and three wheelers.

COURSE OUTCOMES

- Upon successful completion of the course, the students should be able to:
- Construct the frames of two and three wheelers of different layouts.
- Demonstrate the constructional details and principle of operation of various engine components.
- Identify and explain the types of transmission systems.
- Identify and explain the types of steering and suspension systems.
- Classify and describe the types of wheels, tyres and brakes for two and three wheelers.
- Explain the servicing of two and three wheelers.

UNIT I INTRODUCTION 9

Classifications- design considerations –weight and dimension limitations – requirements stability problems, gyroscopic effect- pendulum effect of two and three wheelers.

UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS 9

2 stoke and 4 stoke SI engines and CI engines design criteria– design of cylinders, cylinder head, cooling fins, crank case, connecting rod and crank shaft. Carburetor types and design. Battery coil ignition, magneto ignition and electronic ignition. Lighting and other electrical system.

UNIT III CLUTCHES AND TRANSMISSION 9

Types of clutches for 2 and 3 wheelers.Design of clutch system.Gears for two and three wheelers.Design of gear box and gear change mechanism. Belt, chain and shaft drive. Freewheeling devices, starting systems.

UNIT IV FRAMES, SUSPENSION, WHEELS AND TYRES 9

Types of frames used for two wheelers and three wheelers. Wheel frames- construction design of frames for fatigue strength torsional stiffness and lateral stability. Front and rear forks. Springs for suspension, Dampers, constructional details of wheel and tyres.

UNIT V THREE WHEELERS 9

Auto rickshaws, different types, Pick-Ups and delivery type vehicle, frames and transmission for 3 wheelers wheel types, wheel attachment tyre types. Brakes and their operating mechanism.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Irving P.E.	Motor Cycle Engineering.	Temple Press Book, London.	1992
2.	Srinivasan.S.	Motor cycle, Scooter, Mobeds.	New century book house.	1988.

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	M.M.Griffin.	Motor cycles from inside and outside.	Prentice Hall Inc, New Jersey.	1978
2.	Bruce A. Johns, David D.Edmundson and Robert Scharff	Motorcycles: Fundamentals, Service, Repair	Goodheart-Willcox	1999

19BEAEOE03 AUTOMOBILE MAINTENANCE L T P C

3 0 0 3

COURSE OBJECTIVE

- The objective of this course is to make the students to know and understand the maintenance and fault diagnosis of basic systems in Automobile.
- Describe and differentiate the types of maintenance.
- List the procedure for dismantling, servicing and assembling of engine components.
- Demonstrate the servicing of transmission and driveline components.
- Discuss the procedure for steering and suspension
- Discuss the procedure for wheel and brake maintenance.

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

- Describe and differentiate the types of maintenance.
- List the procedure for dismantling, servicing and assembling of engine components.

- Demonstrate the servicing of transmission and driveline components.
- Discuss the procedure for steering and suspension
- Discuss the procedure for wheel and brake maintenance.
- Explain the fault diagnosis in the electrical and air conditioner systems

UNIT I MAINTENANCE OF RECORDS AND SCHEDULES 9

Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists, Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance.

UNIT II ENGINE MAINTENANCE 9

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up.

UNIT III CHASSIS MAINTENANCE 9

Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system, Maintenance servicing of suspension systems. Brake systems, types and servicing techniques, Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

UNIT IV ELECTRICAL SYSTEM MAINTENANCE 9

Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems, Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.

UNIT V MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VEHICLE BODY 9

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply, Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives, Lubrication maintenance, lubricating oil changing, greasing of parts, Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance.

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	John Doke	Fleet Management	McGraw Hill Co	1984
2.	James D Halderman	Advanced Engine Performance Diagnosis	Prentice Hall Publications	2011

19BEAEOE04 INTRODUCTION TO MODERN VEHICLE TECHNOLOGY L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on trends in the vehicle power plants.
- To learn the various advanced driver assistance systems.
- To study the working of advanced suspension and braking systems in an automobile.
- To give information about motor vehicle emission and noise pollution control.
- To provide knowledge of the vehicle telematics.
- To give information about the noise control techniques.

COURSE OUTCOMES

Upon successful completion of the course, the students should be able to:

- Distinguish and describe the various modern vehicle power plant systems.
- List and explain the various driver assistant mechanisms.
- Identify and describe the working of advanced suspension and braking systems.
- Apply the knowledge of motor vehicle emission and noise pollution control.
- Describe the noise control techniques

- Describe the vehicle telematics and its applications

UNIT I TRENDS IN POWER PLANTS 9

Hybrid vehicles - Stratified charged / learn burn engines - Hydrogen engines - battery vehicles – Electric propulsion with cables - Magnetic track vehicles.

UNIT II DRIVER ASSISTANCE SYSTEMS 9

Collision Avoidance Systems, Adaptive cruise control, adaptive noise control, anti-spin regulation, traction control systems, cylinder cut- off technology, ABS, Driver Drowsiness Detection system

UNIT III SUSPENSION BRAKES AND SAFETY 9

Air suspension - Closed loop suspension - antiskid braking system, Retarders, Regenerative braking safety cage - air bags - crash resistance - passenger comfort.

UNIT IV NOISE & POLLUTION 9

Reduction of noise - Internal & external pollution control through alternate fuels/power plants – Catalytic converters and filters for particulate emission.

UNIT V TELEMATICS 9

Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition

Total: 45

TEXT BOOKS

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	LjuboVlacic, Michael Saren and Fumio Harashima	Intelligent Vehicle Technologies	Butterworth-Heinemann publications, Oxford	2001
2.	Ronald K.Jurgen	Navigation and Intelligent Transportation Systems – Progress in Technology	Automotive Electronics Series,SAE, USA.	1998

REFERENCES

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	William B Riddens	"Understanding Automotive Electronics", 5th Edition	Butterworth Heinemann Woburn.	1998
2.	Bechhold,	"Understanding Automotive Electronics"	SAE	1998
3.	Robert Bosch,	"Automotive HandBook", 5th Edition	SAE	2000

LIST OF OPEN ELECTIVES OFFERED BY CIVIL ENGINEERING DEPARTMENT

19BECEOE01 HOUSING, PLAN AND MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE:

- Teach them introduction to housing
- Make them aware ofFormulation of Housing Projects
- Impart knowledge about construction techniques and cost-effective materials
- Learn about Formulation of Housing Projects
- Understand Site analysis
- Learn about Layout design

COURSE OUTCOME

At the end of the this course the students should have learnt

- the basic terms of housing programmes,
- planning and designing of housing projects,
- Know conssstruction techniques and
- Understand cost effective materials and
- familiarise housing finance
- Know Project appraisal techniques.

UNIT I INTRODUCTION TO HOUSING 9

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES 9

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organisations.

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS 9

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS 9

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL 9

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing o f Housing Units, Rents, Recovery Pattern (Problems).

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Meera Mehta and Dinesh Mehta	Metropolitan Housing Markets	Sage Publications Pvt. Ltd., New Delhi	2002
2.	Francis Cherunilam and Odeyar D Heggade	Housing in India	Himalaya Publishing House, Bombay	2001

REFERENCES:

S.NO.	Title of the book	Year of publication
1.	Development Control Rules for Chennai Metropolitan Area,CMAM Chennai	2002
2.	UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi	2000

19BECEOE02 BUILDING SERVICES L T P C

3 0 0 3

COURSE OBJECTIVES

- Defining and identifying of eng. services systems in buildings.
- The role of eng. services systems in providing comfort and facilitating life of users of the building.
- The basic principles of asset management in a building & facilities maintenance environment
- Importance of Fire safety and its installation techniques
- To Know the principle of Refrigeration and application
- To Understand Electrical system and its selection criteria

COURSE OUTCOME

The students will be able to

- Machineries involved in building construction
- Understand Electrical system and its selection criteria
- Use the Principles of illumination & design
- Know the principle of Refrigeration and application
- Importance of Fire safety and its installation techniques
- Know the principle behind the installation of building services and to ensure safety in buildings

UNIT I MACHINERIES 9

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

UNIT II ELECTRICAL SYSTEMS IN BUILDINGS 9

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

UNIT III PRINCIPLES OF ILLUMINATION & DESIGN 9

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilisation factor – Depreciation factor – MSCP – MHCP – Lans of illumination – Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

UNIT IV REFRIGERATION PRINCIPLES & APPLICATIONS 9

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Subcooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

UNIT V FIRE SAFETY INSTALLATION 9

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	E.R.Ambrose	Heat Pumps and Electric Heating	John and Wiley and Sons, Inc., NewYork	2002
2.	Handbook for Building Engineers in Metric systems		NBC, New Delhi	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Philips Lighting in Architectural Design		McGraw-Hill, New York	2000
2.	A.F.C. Sherratt	Air-conditioning and Energy Conservation	The Architectural Press London	2005
3.	National Building Code			

19BECEOE03 MANAGEMENT OF IRRIGATION SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To enable the students for a successful career as water management professionals.
- To create a potential among students in the area of irrigation management with specific enrichment to synthesis of data and their analysis.
- To expose the students the need for an interdisciplinary approach in irrigation water management
- To providing a platform to work in an interdisciplinary team.
- To provide students an ability to understand the applications of mathematical and scientific concepts to analyse intricate technical, social and environmental problems in irrigation water management and finding solutions for them.
- To promote student awareness for a life-long learning process and inculcate professional ethics and codes of professional practice in water management.

OUTCOME

At the end of this the students will be in a capacity to

- Understand the concepts of soil-water-plant relationship as well as to expose them to the principles and practices of crop production.
- Exposure to ground water, hydraulics of ground water related to drainage, drainage concepts, planning, design and management of drainage related irrigation system management
- Understand the various principles of irrigation management and to analyse the different types of irrigation systems and their performances based on service oriented approach.
- Gain insight on local and global perceptions and approaches to participatory water resource management
- Learn from successes and failures in the context of both rural and urban communities of water management.
- Exposure on the use of economic concepts in irrigation development and to impart knowledge on economic planning so as to enable viable allocation of resources in the irrigation sector.

UNIT I IRRIGATION SYSTEM REQUIREMENTS 9

Irrigation systems – Supply and demand of water – Cropping pattern – Crop rotation – Crop diversification – Estimation of total and peak crop water requirements – Effective and dependable rainfall – Irrigation efficiencies.

UNIT II IRRIGATION SCHEDULING 9

Time of irrigation – Critical stages of water need of crops – Criteria for scheduling irrigation – Frequency and interval of irrigation.

UNIT III MANAGEMENT 9

Structural and non-structural strategies in water use and management – Conjunctive use of surface and ground waters – Quality of irrigation water.

UNIT IV OPERATION 9

Operational plans – Main canals, laterals and field channels – Water control and regulating structures – Performance indicators – Case study.

UNIT V INVOLVEMENT OF STAKE HOLDERS 9

Farmer's participation in System operation – Water user's associations – Farmer councils – Changing paradigms on irrigation management – Participatory irrigation management

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Dilip Kumar Majumdar	Irrigation Water Management – Principles and Practice	Prentice Hall of India Pvt. Ltd., New Delhi	2000
2.	Hand book on Irrigation Water Requirement R.T. Gandhi, et. al., Water Management Division, Department of Agriculture, Ministry of Agriculture, New Delhi			

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Maloney, C. and Raju, K.V	Managing Irrigation TogetherPractice	Stage Publication, New Delhi, India	2000

19BECEOE04 ADVANCED CONSTRUCTION TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To give an experience in the implementation of new technology concepts which are applied in field of Advanced construction.
- To study different methods of construction to successfully achieve the structural design with recommended specifications.
- To involve the application of scientific and technological principles of planning, analysis, design and management to construction technology.
- To study of construction equipment's, and temporary works required to facilitate the construction process
- To provide a coherent development to the students for the courses in sector of Advanced construction technology.
- To present the new technology of civil Engineering and concepts related Advanced construction technology.

OUTCOMES:

- Implementation of new technology concepts which are applied in field of Advanced construction.
- Different methods of construction to successfully achieve the structural design with recommended specifications.
- Application of scientific and technological principles of planning, analysis, design and management to construction technology.
- Will gain the Knowledge of construction equipment's, and temporary works required to facilitate the construction process
- Development to the students for the courses in sector of Advanced construction technology.
- The new technology of civil Engineering and concepts related Advanced construction technology.

UNIT - I MODERN CONSTRUCTION METHODS
9

Open Excavation, Shafts and Tunnels- Preparation of foundation, Cofferdams, Caisson, Piled Foundation, Prestressed Concrete Construction, Pre-cast Concrete Construction.

UNIT - II CONSTRUCTION METHODS FOR SPECIAL STRUCTURES
9

Construction Methods For Bridges, Construction Methods for Roads, Construction Methods For Special Structures for Railways, Construction Methods for Dams, Construction Methods for Harbour, Construction Methods for River Works Pipelines. Construction Methods for River Works Pipelines.

UNIT - III MODERN CONSTRUCTION EQUIPEMENTS -I

9

Construction Equipment used for Earth Moving, Excavating, Drilling, Blasting, Tunneling and hoisting.

UNIT - IV MODERN CONSTRUCTION EQUIPEMENTS -II

9

Construction Equipment used for Conveying, Hoisting, Dredging, Dewatering Systems, Paving and concreting Plant.

UNIT - V PRINCIPLES AND PRACTICES OF TEMPORARY STRUCTURES

9

Principles and Practices of Temporary structures, Shoring, and Strutting,Underpinning, Principles and Design of Formwork, Scaffolding, Operation and maintenance of construction equipments

Total: 45

TEXTBOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Peurifoyu , R. L., , Ledbette, W.B	Construction Planning , Equipment and Methods	McGraw Hill Co.	2000
2.	Antill J.M	PWD, Civil Engineering Construction	McGraw Hill Book Co	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1.	Varma, M	Construction Equipment	Metropoltian	2000

		and its Planning & Applications	Book Co	
2.	Nunnaly, S.W	Construction Methods and Management	Prentice – Hall	2000
3.	Ataev, S.S	Construction Technology	MIR , Pub	2000