118PHT03 **ENGINEERING PHYSICS** | L | T | P | C |

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

- To understand the concept of properties of matter.
- To understand the properties of sound and principles of quantization of energy.
- To understand the properties of coherent light and its importance.

UNIT-I   PROPERTIES OF MATTER   9

Elasticity – Stress – Strain diagram – Factors affecting elasticity – Twisting couple on a wire – Torsion pendulum – Young's modulus - cantilever – Uniform and Non uniform bending (theory and experiment)–Viscosity-Poiseuille's method for Coefficient of Viscosity (Qualitative).

UNIT-II   ACOUSTICS AND ULTRASONICS   9

Classification of sound, loudness, intensity – Decibel – Weber Fechner Law – Reverberation and Reverberation time – derivation of Sabine's formula for Reverberation time (Growth and Decay)– Absorption coefficient and its determination. Introduction of Ultrasonics – Production – magnetostriction effect – magnetostriction generator– piezoelectric effect – piezoelectric generator – Detection of ultrasonic waves, properties – Cavitation – Applications – Depth of sea – Non Destructive Testing.

UNIT-III   QUANTUM PHYSICS   9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh–jeans' Law from Planck's theory – Compton Effect–derivation– Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box – Degeneracy and Non-degeneracy.

UNIT-IV   LASER   9

Introduction – Principle of Spontaneous emission and stimulated emission – Population inversion – pumping – Einstein's A and B coefficients – derivation – Types of lasers – He-Ne, CO_2, Nd-YAG, Semiconductor lasers – homojunction – Applications of Laser.

UNIT-V   WAVE OPTICS & FIBRE OPTICS   9

Interference – Air wedge (theory & experiment) – Polarization– Methods of polarizing light- Theory of plane circularly and elliptically polarized light. Principle and propagation of light in optical fibers – Numerical aperture and Acceptance angle– Types of optical fibers (material, refractive index, and mode) – Fiber optical communication system (Block diagram) – Fiber optic sensors – Temperature & Displacement sensors (Qualitative).

TOTAL HOURS: 45 PERIODS

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COURSE OUTCOMES:

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

CO1: To understand properties of solids with different types of moduli and to gain knowledgeabout absorption coefficients of solids and different surfaces.

CO2: To understand basic concepts of high frequency sound waves and its applications.

CO3: To understand basic concepts of quantum mechanical behavior of wave and particlealong with applications.

CO4: To understand the concepts of production of laser and its behavior with diffraction principle of interference.

CO5: To apply the concept of polarization phenomenon and thereby its applications in fiber optic communication.

TEXT BOOKS:
1. R.K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi(2003)
2. Jayaprakash R.N, 'Engineering Physics - I', Dhanam Publications, Chennai, (2007).

REFRENCE BOOKS:
1. Dr.M.N.Avadhanulu, Introduction to Lasers: theory and applications S.Chand publications 2012, New Delhi.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	To understand properties of solids with different types of moduli and to gain knowledgeabout absorption coefficients of solids and different surfaces.	2		1		2		2		1		1	2	1	2	2
CO2	To understand basic concepts of high frequency sound waves and its applications		1	2	1		1		1	2	2		1		1	1
CO3	To understand basic concepts of quantum mechanical behavior of wave and particlealong with applications.	2		1		2		2		1		1	2	1	2	2
CO4	To understand the concepts of production of laser and its behavior with diffraction principle of interference.	2		1		2		2		1		1	2	1	2	2
CO5	To apply the concept of polarization phenomenon and thereby its applications in fiberoptic communication.	2		1		2		2		1		1	2	1	2	2

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COURSE OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To recall the terminologies of electrochemistry and explain the function of batteries andfuel cells with its electrochemical reactions.
- To understand the fundamentals of corrosion, its types and polymers with its applications.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems -Alkalinity-types of alkalinity-determination of alkaninity-boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (carbonate, colloidal, phosphate and calgon conditioning) external treatment Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

UNIT II ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES 9

Electrochemical cell-single electrode potential-standard electrode potential-electrochemical series and its significance-EMF of a cell- Nernst equation -Electrodes-Reference electrodes-hydrogen, calomel, quinhydrone and glass electrodes. Determination of pH of a solution using a glass electrode. Batteries - primary and secondary cells, dry cell, alkaline, lead acid storage cell, Ni-Cd battery and lithium nano battery. Clean energy fuel cells - H2-O2 fuel cell.

UNIT III CORROSION SCIENCE 9

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion − Pilling Bedworth ratio - types of oxide layer (stable, unstable, volatile, porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current Cathodic protection method - electroplating - electroless plating.

UNIT IV POLYMERS AND ITS PROCESSING 9

Monomers - polymers - polymerization - functionality − degree of polymerization - classification of polymers based on source and applications - Molecular weight determination. Types of polymerization: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of PE, PVC, Teflon, terylene, Nylon and Bakelite. Rubber-drawbacks of natural rubber-Vulcanization-Compounding of plastics - injection and blow moulding methods.

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. **Combustion of fuels:** Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.

CO2: Construct an electrochemical cell and Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.

CO3: Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.

CO4: Differentiate the polymers used in day to day life based on its source, properties and applications.

CO5: Analyse the three types of fuels based on calorific value for selected application.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi,2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", CambridgeUniversity Press, Delhi, 2015.

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	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.		1	2	1		1		1	2	2		1		1	1
CO2	Construct an electrochemical cell and Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.		1	2	1		1		1	2	2		1		1	1
CO3	Utilize electrochemical data to formulate an electrochemical half-cell and cell reactions for corrosion control processes.	2		1		2		2		1		1	2	1	2	2
CO4	Differentiate the polymers used in day to day life based on its source, properties and applications.	2		1		2		2		1		1	2	1	2	2
CO5	Analyse the three types of fuels based on calorific value for selected application.		1	2	1		1		1	2	2		1		1	1

118PPT05	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE 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 define Python functions and call them.
- To use Python data structures -- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I   ALGORITHMIC PROBLEM SOLVING   9

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   9

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   9

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; Arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV   LISTS, TUPLES, DICTIONARIES   9

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, merge sort, histogram.

UNIT V   FILES, MODULES, PACKAGES   9

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

COURSE OUTCOMES:

Upon completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Read, write, execute by hand simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.

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CO5: Represent compound data using Python lists, tuples, and dictionaries.

TOTAL HOURS: 45 PERIODS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, 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.

REFERENCE BOOKS:

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revisedand expanded Edition, 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) Private Ltd., 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning,2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A ComputationalProblem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Develop algorithmic solutions to simple computational problems	2		1		2		2		1		1	2	1	2	2
CO2	Read, write, execute by hand simple Python programs.		1	2	1		1		1	2	2		1		1	1
CO3	Structure simple Python programs for solving problems.		1	2	1		1		1	2	2		1		1	1
CO4	Decompose a Python program into functions.	2		1		2		2		1		1	2	1	2	2
CO5	Represent compound data using Python lists, tuples, dictionaries.	2		1		2		2	3	1		1	2	1	2	2

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118ESE01   **BASIC CIVIL AND MECHANICAL ENGINEERING**   L T P C

                                                                           3 0 0 3

COURSE OBJECTIVES:

To gain the knowledge on civil works like masonry, roofing, flooring and plastering.

To gain the knowledge on stress, strain of various building and foundations.

The students should familiar with foundry, welding and forging processes.

The students should familiar working principle of IC engines and its types.

To gain the knowledge about various energy recources and refrigeration air condition systems.

A – CIVIL ENGINEERING

UNIT I   **SURVEYING AND CIVIL ENGINEERING MATERIALS**   **9**

Surveying: Objects, types, classification, principles, measurements of distances, angles, leveling, determination of areas, illustrative examples. **Civil Engineering Materials:** Bricks, stones, sand, cement, concrete, steel sections.

UNIT II   **BUILDING COMPONENTS AND STRUCTURES**   **10**

Foundations: Types, Bearing capacity, Requirement of good foundations. **Superstructure:** Brick masonry, stone masonry, beams, columns, lintels, roofing, flooring, plastering, Mechanics, Internal and external forces, Stress, Strain, Elasticity, Types of Bridges and Dams, Basics of Interior Designand Landscaping.

B – MECHANICAL ENGINEERING

UNIT III   **FOUNDRY WELDING AND FORGING**   **10**

Foundry: Introduction - Patterns –materials. Types of pattern and pattern allowances. Molding sand, types and properties, Molding procedure. **Welding:** Definition and Classification, Gas welding, Oxy Acetylene welding, Types of flames, advantages and disadvantages of gas welding. Resistance welding - Classification, Spot welding and Seam welding. Soldering, Definition and Classification. Brazing – Definition and Classification. **Forging:** Types of Forging, Differences between Hot working and Cold working processes.

UNIT IV   **IC ENGINES& BOILERS**   **8**

Internal combustion engines, Working principle of Petrol and Diesel Engines, Four stroke and Two stroke cycles, Comparison of four stroke and two stroke engines, Boilers: Introduction of boilers, classification, Lancashire boiler, Babcock and Wilcox boiler, list of boiler mountings and accessories and applications (no sketches).

UNIT V   **SOURCE OF ENERGY&REFRIGERATION**   **8**

Sources of energy: Introduction, conventional and non-conventional sources of energy, examples, solar energy, hydro power plant. Introduction to refrigeration and air-conditioning, COP, properties of refrigerants and types of refrigerants, working principle of vapour compression & vapour absorption refrigeration system, Layout of typical domestic

refrigerator, Window and Split type room Air conditioner.

TOTAL HOURS: 45 HOURS

COURSE OUTCOMES:

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

CO1: The usage of surveying and properties of construction materials.

CO2: The stress strain of various building and material such as substructure, road transport and bridge.

CO3: The concept of manufacturing methods encountered in engineering practice such as foundry, welding and forging processes.

CO4: The working of internal combustion engines and its types.

CO5: The concept of energy conservation in practical, power plant refrigeration air condition andits types.

TEXT BOOKS:

1. Ranganath G and Channankaiah, "Basic Engineering Civil & Mechanical", S.S.Publishers,2014.

2. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2012.

REFERENCE BOOKS:

1. Venugopal.K and PrabhuRaja.V, "Basic Mechanical Engineering", Anuradha Publishers,Kumbakonam, 2015.

2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd, 3rd Edition reprint, 2013.

3. Shanmugasundaram. S and Mylsamy. K, "Basics of Civil and Mechanical Engineering",Cenage Learning India Pvt.Ltd, NewDelhi, 2012.

4. Khanna O.P, Foundry Technology, Dhanpat Rai Publishing Co. (P) Ltd, 2011.

5. Shanmugam G., "Basic Mechanical Engineering", Tata McGraw Hill Publishing Co., NewDelhi, 2010.

6. Gopalakrishna K R, "Elements of Mechanical Engineering", Subhas Publications, Bangalore,2008.

7. Shantha Kumar S R J, "Basic Mechanical Engineering", Hi-Tech Publications,Mayiladuthurai, 2001.

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	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	The usage of surveying and properties of construction materials.		1	2	1		1		1	2	2		1		1	1
CO2	The stress strain of various building and material such as substructure, road transportand bridge.	2		1		2		2		1		1	2	1	2	2
CO3	The concept of manufacturing methods encountered in engineering practice such asfoundry, elding and forging processes.	2		1		2		2		1		1	2	1	2	2
CO4	The working of internal combustion engines and its types.		1	2	1		1		1	2	2		1		1	1
CO5	The concept of energy conservation in practical, power plant refrigeration air condition andits types.	2		1		2		2		1		1	2	1	2	2

118PHP07	ENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To understand the practical concepts of Interference and diffraction.
- To understand the concept of velocities of sound in different liquids.
- To get better knowledge of modulus of elasticity.
- To understand the concepts of thermal conductivity.
- To understand the concepts of viscosities of liquid

LIST OF EXPERIMENTS

1. (a) Determination of laser parameters – Wavelength.
   (b) Particle size determination using Diode Laser.
2. Determination of thickness of a thin wire-Air wedge method.
3. Determination of velocity of sound and compressibility of liquid- Ultrasonicinterferometer.
4. Determination of wavelength of mercury spectrum-Spectrometer grating.
5. Determination of thermal conductivity of a bad conductor-Lee's disc method.
6. Determination of Young's modulus of the material –Non uniform bending.
7. Determination of viscosity of liquid – Poiseuille's method.
8. Spectrometer- Dispersive power of prism.
9. Determination of Young's modulus of the material - Uniform bending.
10. Tensional pendulum- Determination of Rigidity modulus.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understanding the moduli of elasticity by determining Young's modulus and Rigiditymodulus of a beam and cylinder respectively.

CO2: Understanding the phenomenon of diffraction, dispersion and interference of light usingoptical component

CO3: Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid andmeasuring the parameters of ultrasound propagating through a liquid

CO4: Understanding the p h e n o m e n o n of h e a t transfer t h r o u g h conductors and b a d conductors by determining thermal conductivity.

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COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understanding the moduli of elasticity by determining Young's modulus and Rigiditymodulus of a beam and cylinder respectively.	2		1		2		2		1		1	2	1	2	2
CO2	Understanding the phenomenon of diffraction, dispersion and interference of light usingoptical component		1	2	1		1		1	2	2		1		1	1
CO3	Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid andmeasuring the parameters of ultrasound propagating through a liquid	2		1		2		2		1		1	2	1	2	2
CO4	Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.		1	2	1		1		1	2	2		1		1	1

118PPP08	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	L	T	P	C
	LABORATORY	0	0	2	1

COURSE OBJECTIVE:
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS:
1. To Implement python scripts using Variables and operators
2. To Demonstrate Operator precedence to evaluate an expression
3. Display grade of a student using elif statement
4. Implement Floyd triangle using for loop
5. Checks the given number is prime or not using while loop
6. Compute the GCD of Numbers using functions
7. Finding factorial of a given number using recursive function.
8. Takes a list of words and returns the length of longest one using strings
9. To perform linear and binary search using strings
10. To implement list as arrays (multiply 2 matrices)
11. To demonstrate use of list & related functions
12. To demonstrate use of tuple, set& related functions
13. To demonstrate use of Dictionary& related functions
14. Finding most frequent words in a text read from a file
15. Programs that take command line arguments (word count)

TOTAL HOURS: 45 PERIODS

PLATFORM NEEDED
Python 3 interpreter for Windows/Linux

COURSE OUTCOMES:

Upon completion of the course, students will be able to:
CO1: Write, test, and debug simple Python programs.
CO2: Implement Python Programs with conditionals and loops.
CO3: Develop Python programs step-wise by defining functions and calling them.
CO4: Use Python lists, tuples, dictionaries for representing compound data.
CO5: Read and write data from/to files in Python.

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	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Write, test, and debug simple Python programs.	2		1		2		2		1		1	2	1	2	2
CO2	Implement Python Programs with conditionals and loops		1	2	1		1		1	2	2		1		1	1
CO3	Develop Python programs step-wise by defining functions and calling them.		1	2	1		1		1	2	2		1		1	1
CO4	Use Python lists, tuples, dictionaries for representing compound data.	2		1		2		2		1		1	2	1	2	2
CO5	Read and write data from/to files in Python.	2		1		2		2	3	1		1	2	1	2	2

218GET03	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I   NATURAL RESOURCES   14

Definition, scope and importance of environment − need for public awareness − Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people − Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems − Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies − Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies − Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies − Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification − role of an individual in conservation of natural resources − Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets − river / forest / grassland / hill / mountain.

UNIT II   ECOSYSTEMSANDBIODIVERSITY   8

Concept of an ecosystem − structure and function of an ecosystem − producers, consumers and decomposers −energy flow in the ecosystem − ecological succession − food chains, food webs and ecological pyramids − Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) − Introduction to biodiversity definition: genetic, species and ecosystem diversity − biogeographical classification of India − value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values − Biodiversity at global, national and local levels − India as a mega-diversity nation − hot-spots of biodiversity − threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts − endangered and endemic species of India −conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems − pond, river, hill slopes.

UNIT III   ENVIRONMENTAL POLLUTION   10

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV   SOCIAL ISSUES AND THE ENVIRONMENT   7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V   HUMAN POPULATION AND THE ENVIRONMENT   6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Gain knowledge about environment and ecosystem.

CO2: Learn about natural resource, its importance and environmental impacts of human activities on natural resource.

CO3: Gain knowledge about the conservation of biodiversity and its importance

CO4: Aware about problems of environmental pollution, its impact on human and ecosystem and control measures.

CO5: Learn about increase in population growth and its impact on environment

TEXT BOOKS:

1. Benny Joseph, Environmental Science and Engineering ', Tata McGraw-Hill, New Delhi,2006.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science ', 2nd

edition, Pearson Education, 2004.

3. Dr. G. Ranganath, Environmental Science and Engineering, Sahana Publishers, 2018 edition.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, Environmental law ', Prentice hall of India PVT LTD, New Delhi,2007.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Gain knowledge about environment and ecosystem.	2		1		2		2		1		1	2	1	2	2
CO2	Learn about natural resource, its importance and environmental impacts of human activities on natural resource.		1	2	1		1		1	2	2		1		1	1
CO3	Gain knowledge about the conservation of biodiversity and its importance	2		1		2		2		1		1	2	1	2	2
CO4	Aware about problems of environmental pollution, its impact on human and ecosystem and control measures.	2		1		2		2		1		1	2	1	2	2
CO5	Learn about increase in population growth and its impact on environment	2		1		2		2		1		1	2	1	2	2

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218EGT04	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

COURSE OBJECTIVES:

- To understand the graphical skills for drawing the object and the principle of free-hand sketchingtechniques.
- To understand the principle of orthographic projection of points, lines and plane surfaces.
- To study the principle of simple solids.
- To understand the principle of section and development of solids.
- To understand the principle of Isometric and Perspective projections.

Concepts and conventions (Not for Examination)   **3**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions andspecifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I   PLANE CURVES AND FREE HAND SKETCHING   15

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by Eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II   PROJECTION OF POINTS, LINES AND PLANE SURFACES   15

Projection of points and straight lines located in the first quadrant – Determination of true lengths andtrue inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT III   PROJECTION OF SOLIDS   15

Projection of simple solids like prisms, pyramids, cylinders and cones when the axis is inclined to onereference plane by change of position method.

UNIT IV   SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES   15

Sectioning of simple solids like prisms, pyramids, cylinders and cones in simple vertical position

by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V   ISOMETRIC AND PERSPECTIVE PROJECTIONS   **12**

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncatedprisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL HOURS: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Recognize the conventions and apply dimensioning concepts while drafting simple objects.

CO2: Draw the orthographic projection of points, line, and plane surfaces.

CO3: Draw the orthographic projection of simple solids.

CO4: Draw the section of solid drawings and development of surfaces of the given objects.

CO5: Apply the concepts of isometric and perspective projection in engineering practice.

TEXT BOOKS:

1. Ranganath G, Channankaiah and Halesh Koti, "Engineering Graphics", Second Edition, Sahana Publishers, 2015.

2. Bhatt. N.D., "Engineering Drawing" Charotar Publishing House, 53th Edition, 2014.

REFERENCE BOOKS:

1. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw HillPublishing Company Limited, 2017.

2. Gopalakrishnana. K. R, "Engineering Drawing" (Vol. I & II), Subhas Publications, 2014.

3. Basant Agarwal and C.M.Agarwal, "Engineering Drawing", Tata McGraw Hill, 2013.

4. Natrajan K. V, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai,2012.

5. M.B.Shaw and B.C.Rana, "Engineering Drawing", Pearson Education India, 2011.

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COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Recognize the conventions and apply dimensioning concepts while drafting simple objects.		1	2	1		1		1	2	2		1		1	1
CO2	Draw the orthographic projection of points, line, and plane surfaces.		1	2	1		1		1	2	2		1		1	1
CO3	Draw the orthographic projection of simple solids.	2		1		2		2		1		1	2	1	2	2
CO4	Draw the section of solid drawings and development of surfaces of the given objects.	2		1		2		2	3	1		1	2	1	2	2
CO5	Apply the concepts of isometric and perspective projection in engineering practice.	2		1		2		2		1		1	2	1	2	2

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218EDT05	ELECTRIC CIRCUITS AND ELECTRON DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Analyze the two port networks using different techniques
- Analyze the transient response in RLC circuits
- Discuss the concept of intrinsic and extrinsic semiconductors and its characteristics
- Infer the concept of different configurations of transistor and their characteristics
- Study the various forms of semiconductors devices

UNIT-I   CIRCUIT ANALYSIS TECHNIQUES   9

Kirchhoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion. (Include Topic: General Methods of Network Analysis (mesh & nodal analysis)

UNIT - II   TRANSIENT RESONANCE IN RLC CIRCUITS   9

Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

UNIT – III   SEMICONDUCTOR DIODES   9

Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

UNIT - IV   TRANSISTORS   9

Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N- Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation –comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT – V   SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only)   9

Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistors equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze the two port networks using different techniques
CO2: Compute transient response in RLC circuits

CO3: Describe the concept of intrinsic and extrinsic semiconductors and its characteristics
CO4: Explain the concept of transistor configurations and their applications
CO5: Recognize the various forms of semiconductors devices and their characteristics.

TEXT BOOKS:

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series, TMH, 2001.
2. S. Salivahanan, N. Suresh kumar and A. Vallavaraj, "Electronic Devices and Circuits", 2nd Edition, 2008.

REFERENCE BOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
2. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, 2006.
3. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering CircuitAnalysis", TMH, 6th Edition, 2002.
4. J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits", TMH, 2nd Education, 2008.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze the two port networks using different techniques			2	3										2	
CO2	Compute transient response in RLC circuits			2	3										2	
CO3	Describe the concept of intrinsic and extrinsic semiconductors and its characteristics	3		3											2	
CO4	Explain the concept of transistor configurations and their applications	3		3											2	
CO5	Recognize the various forms of semiconductors devices and their characteristics.	3		3											2	

218BSE08	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To study the basic theory of structure of crystalline materials.
- To understand the essential principles of electrical properties of materials.
- To get the better knowledge of Physics of semiconductor materials.
- Become proficient in dielectric properties of materials.
- To understand the essential concepts of nanomaterial devices and applications

UNIT I   CRYSTALLOGRAPHY   9

Crystal structures- Parameters- Bravais lattice - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - Packing factor for SC, BCC, FCC, HCP and Diamond cubic structure - NaCl, ZnS structures (qualitative). Miller indices- unit cell approach.

UNIT II   ELECTRICAL PROPERTIES OF MATERIALS   9

Classical free electron theory-Expression for electrical conductivity-Thermal conductivity, Expression-Wiedemann-Franz law-Success and failures-Quantum free electron theory-Particle in a finite potential well-Tunneling-Particle in a three dimensional box-degenerate States-Fermi- Dirac statistics-Density of energy states-Energy bands in solids.

UNIT III   SEMICONDUCTORS AND TRANSPORT PHYSICS   9

Intrinsic Semiconductors-Energy band diagram-direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors-extrinsic semiconductors-Carrier concentration in N-type & P-type semiconductors (qualitative) -Variation of carrier concentration with temperature -Hall effect and devices-Ohmic contacts-Schottky diode.

UNIT IV   DIELECTRIC MATERIALS   9

Dielectrics: Dielectric constant - Dielectric loss - Electrical susceptibility- Electronic, ionic - orientational and space charge polarization - Frequency and temperature dependence of polarization - internal field - Claussius - Mosotti relation (derivation) - Thermal conductivity by Lee's disc method for dielectric material.

UNIT V   NANOMATERIAL DEVICES   9

Nano materials: Introduction – Synthesis – Plasma arcing – Chemical vapour deposition – Electrodeposition – Ball Milling – Sol-Gel method – Spin coating method- photo current in a P-N diode –Solar cell – LED- Properties of nanoparticles and their applications.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Have the necessary understanding on the functioning of crystalline in solids of materials.

CO2: Gain knowledge on classical and quantum electron theories, and energy band structures.

CO3: Acquire knowledge on basics of semiconductor physics and its applications in various devices.

CO4: Get knowledge on dielectric properties of materials and their applications.

CO5: Understand the basics of nanodevices and applications.

TEXT/REFERENCE BOOKS:

1. Donald Askeland, "Materials Science and Engineering", Cengage Learning India Pvt Ltd.,2010.

2. Kasap S.O., "Principles of Electronic Materials and Devices" Tata Mc Graw-Hill 2007.Pierret R.F, "Semiconductor Device Fundamentals", Pearson 2006

3. W.D.Callister and D.G.Rethwisch, "Materials Science and Engineering", John Wiley &Sons,Inc., New Jersey (2010).

4. Hanson G.W., "Fundamentals of Nanoelectronics", Pearson Education 2009.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Have the necessary understanding on the functioning of crystalline in solids of materials.	2		1		2		2		1		1	2	1	2	2
CO2	Gain knowledge on classical and quantum electron theories, and energy band structures.		1	2	1		1		1	2	2		1		1	1
CO3	Acquire knowledge on basics of semiconductor physics and its applications in various devices.	2		1		2		2		1		1	2	1	2	2
CO4	Get knowledge on dielectric properties of materials and their applications.	2		1		2		2		1		1	2	1	2	2
CO5	Understand the basics of nanodevices and applications.	2		1		2		2		1		1	2	1	2	2

COURSE OBJECTIVES:

- Verify different Laws for Network circuits
- Verify various Theorems for Network circuits
- Understand the frequency response of resonance circuits
- Study the characteristics of various semiconductor devices

LIST OF EXPERIMENTS:

1. Study of Electronic Components, Equipments and color coding of Resistors.
2. Verification of KVL and KCL
3. Verification of Thevenin and Norton Theorems.
4. Verification of superposition Theorem.
5. Verification of Maximum power transfer Theorem.
6. Frequency response of series and parallel resonance circuits.
7. Characteristics of PN and Zener diode
8. Characteristics of CE configuration
9. Characteristics of CB configuration
10. Characteristics of UJT and SCR
11. Characteristics of JFET and MOSFET.
12. Characteristics of DIAC and TRIAC.
13. Characteristics of Photodiode and Phototransistor.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Demonstrate the different Laws for Network circuits
CO2: Analyze various Theorems for Network circuits
CO3: Determine the frequency response of resonance circuits
CO4: Compute the characteristics of various semiconductor devices

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	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Demonstrate the different Laws for Network circuits	3		3	3										2	
CO2	Analyze various Theorems for Network circuits	3		3	3										2	
CO3	Determine the frequency response of resonance circuits	3		3	3										2	
CO4	Compute the characteristics of various semiconductor devices	3		3	3										2	

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COURSE OBJECTIVES:

- To learn various methods to solve the partial differential equations.
- To introduce Fourier series analysis which plays a vital role in many applications in engineering.
- To understand the boundary value problems and to obtain the solution using partial differential equations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To develop z-transform techniques which analyze the discrete time signals.

UNIT I   PARTIAL DIFFERENTIAL EQUATIONS   9+3

Solutions of first order partial differential equations-Standard types-Singular solutions-Lagrange's Linear equation- Method of grouping and Method of multipliers-Solution of homogeneous and non-homogenous linear equations of second and higher order with constant coefficients.

UNIT II   FOURIER SERIES   9+3

Dirichlet's conditions – General Fourier series – Change of scale - Odd and even functions – Half-range Sine and Cosine series – Parseval's identity applications – Harmonic Analysis.

UNIT III   BOUNDARY VALUE PROBLEMS   9+3

Classification of Partial Differential Equations – Method of separation of Variables – Solutions of one dimensional wave equations and One-dimensional heat equations –Applications using Fourier series solutions in Cartesian coordinates - Steady state solution of two-dimensional heat equation.

UNIT IV   FOURIER TRANSFORM   9+3

Fourier integral theorem – Fourier transform pair - Sine and Cosine transforms – Properties – Fourier Transform of simple functions – Convolution theorem (statement and applications only) – Parseval's identity (statement and applications only).

UNIT V   Z – TRANSFORM   9+3

Z-Transform - Elementary properties and applications – Initial and final value theorems (Statement and applications only) - Inverse Z-Transform – Partial fractions method, Residue theorem method and Convolution theorem (statement and applications only) - Solution of difference equations by applying Z-transforms.

TOTAL HOURS: 45+15=60 PERIODS

COURSE OUTCOMES:

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

CO 1: Know the methods to solve partial differential equations occurring in various physical and engineering problems.

CO 2: Describe an oscillating function which appear in a variety of physical problems by Fourier series helps them to understand its basic nature deeply.

CO 3: Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.

CO 4: Understand the effect of Fourier transform techniques and their applications.

CO 5: Gain the concept of analysis of linear discrete system using Z-transform approach.

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd edition, 2015.

REFERENCE BOOKS:

1. Andrews L.C and Shivamoggi. B.K., "Integral Transforms for Engineers", SPIE Press Book, 1999
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Co., New Delhi, 1995.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition Wiley India, 2016.
4. V.Prameelakaladharan and G.Balaji ,"Engineering Mathematics-III", Amrutha marketing, Chennai,2016.
5. T.Veerarajan,"Engineering Mathematics-III", Tata McGraw-Hill Publishing company, New Delhi,2015.
6. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Engineering Mathematics-III", S.Chand Publishers,2015.

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	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Know the methods to solve partial differential equations occurring in various physical and engineering problems.	3	3	3	1										3	
CO2	Describe an oscillating function which appear in a variety of physical problems by Fourier series helps them to understand its basic nature deeply	3	3	3	1					3			3		3	
CO3	Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.	3	3	3	1					3					3	
CO4	Understand the effect of Fourier transform techniques and their applications	3	3	3	1	1									3	
CO5	Gain the concept of analysis of linear discrete system using Z-transform approach	3	3	3	1	1									3	

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COURSE OBJECTIVES:
- To study the magnetic circuits
- To understand the principle and application of transformers
- To study the principle of operation of DC machines
- To study the principle and operation of AC machines
- Understand the working principle of different types of machines

UNIT I   MAGNETIC CIRCUITS   9
Magnetic effects of electric current, Magnetic circuits, Magnetic materials and B-H relationship, Electromagnetic induction and force, Hysteresis and eddy current losses.

UNIT – II   TRANSFORMERS   9
Principle - Theory of ideal transformer - EMF equation - Construction details of shell and core type transformers - Tests on transformers - Equivalent circuit - Regulation and efficiency of a transformer - Introduction to three - phase transformer connections.

UNIT – III   D.C. MACHINES   9
Construction of D.C. Machines - Principle and theory of operation of D.C. generator - EMF equation - Characteristics of D.C. generators - Armature reaction – Commutation - Principle of operation of D.C. motor - Voltage equation - Torque equation - Types of D.C. motors and their characteristics –Starters - Speed control of D.C. motors - Applications.

UNIT – IV   A.C. MACHINES   9
Principle of alternators: - Constructional details, Equation of induced EMF - Synchronous motor: - Starting methods, Torque, Induction motor:- Construction and principle of operation, Classification of single phase and three phase induction motor, Torque equation, Condition for maximum torque, Starting methods and Speed control of induction motors.

UNIT – V   SPECIAL MACHINES   9
Constructional features of stepper motor – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations. Switched reluctance motor – Brushless D.C motor -Permanent magnet synchronous motor -Repulsion type motor – Universal motor – Hysteresis motor.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Understand the magnetic effects, Magnetic materials in magnetic circuits
CO2: Understand the Construction, operating principle, characteristics, and applications of transformers
CO3: Understand the construction, working, characteristics and applications of DC generators & DC motors
CO4: Understand the principle and operation of AC Machines
CO5: Gain the basic knowledge on Special Machines

TEXT BOOKS:

1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", TMH, 2nd, 2007.

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2. Nagrath.I.J. & Kothari.D.P, "Electrical Machines", Tata McGraw-Hill, New Delhi, 5th edition 2012.
3. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., "Electric Machinery", McGraw- Hill, Singapore, 6th edition 2003.

REFERENCE BOOKS
1. Theraja, B.L., "A Text book of Electrical Technology", Vol.II, S.C Chand and Co., New Delhi, 2007.
2. Del Toro, V., "Electrical Engineering Fundamentals", Prentice Hall of India, New Delhi, 2002.
3. Cotton, H., "Advanced Electrical Technology", Sir Isaac Pitman and Sons Ltd., London, 1999

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the magnetic effects, Magnetic materials in magnetic circuits		2		2			2			2		2		3	
CO2	Understand the Construction, operating principle, characteristics, and applications of transformers	2	2	2				2				2	2		3	
CO3	Understand the construction, working, characteristics and applications of DC generators & DC motors			3					3	3					3	
CO4	Understand the principle and operation of AC Machines			3					3	3					3	
CO5	Gain the basic knowledge on Special Machines			3					3	3					2	

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318BMT03	HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To understand the role of cell components in human physiology
- To understand the importance of blood and related diseases.
- To understand the principle functions of kidney, the regulation of respiration and human circulatory system.
- To develop the basic knowledge of human sensory organs- eye and ear.
- To understand skeletal and digestive systems.

UNIT I   BASICS OF HUMAN BODY   9

Anatomy of a Generalized Cell- The Nucleus, The Plasma Membrane, The Cytoplasm, Cell Extensions, Cell Physiology-Membrane Transport

UNIT II   HEMATOLOGICAL SYSTEM   9

Composition and Functions of blood – Blood Components, Physical Characteristics and Volume, Plasma, Formed Elements, Hematopoiesis, Blood Groups and Transfusions - Human Blood Groups.

UNIT III   RENAL, RESPIRATORY AND CARDIAC SYSTEM   9

Renal System: Structure of Kidney and Nephron. Urine formation and Characteristics, Respiratory System: Functional Anatomy of the Respiratory System, Respiratory Physiology -Mechanisms of Breathing, Oxygen and carbon dioxide transport, Cardiac System: Anatomy of the Heart, Chambers and Associated Great Vessels

UNIT IV   NERVOUS SYSTEM, SENSORY ORGANS AND ENDOCRINE SYSTEM   9

Nervous System: Organization of the Nervous System, Nervous Tissue-Structure and Function-Supporting Cells, Neurons, Central Nervous System-Functional Anatomy of the Brain. Peripheral Nervous System- Structure of a Nerve, Autonomic Nervous System, Endocrine System: Thyroid gland, Adrenal gland, Sensory Organs: Anatomy of the Eye and Ear.

UNIT V   SKELETAL, DIGESTIVE AND REPRODUCTIVE SYSTEM   9

Skeletal System: Structure of Skin and Bone, Bone Formation, and Growth of bone and Remodeling, Joints. Digestive System: Anatomy of the Digestive System, Functions of the Digestive System. Reproductive System: Anatomy of male and female reproductive system

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Understand the importance of transport of substances across the cell membrane.
CO2: Gain knowledge of blood components in blood grouping
CO3: Understand and implement the knowledge on physiology of kidney, respiratory and cardiac cycle.

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CO4: Understand the image formation and vision, sound perception and different types of deafness in the ears.

CO5: Know the significance of digestive system, various bones and reproductive system

TEXT BOOKS:
1. Essential of human Anatomy and Physiology, Elaine.N. Marieb Eight edition, Pearson Education New Delhi ,2007.
2. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins: Pathologic Basis of diseases. WB Saunders Co. 7th edition, 2005.

REFERENCE BOOKS:
1. Review of Medical Physiology, William F.Ganong, 22nd edition, Mc Graw Hill, New Delhi
2. Text book of Physiology, Prof. A.K. Jain, Third edition volume I and II Avichal Publishing company, New Delhi.
3. Essentials of Medical Physiology, K.Sembulingam and Prema Sembulingam, 3rd edition, Jaypee Publications

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the importance of transport of substances across the cell membrane								3			3		3	2	1
CO2	Gain knowledge of blood components in blood grouping	2					2							3	2	1
CO3	Understand and implement the knowledge on physiology of kidney, respiratory and cardiac cycle.	2					2		2			3	3	3	2	1
CO4	Understand the image formation and vision, sound perception and different types of deafness in the ears.	2					2		2			2	3	2	3	1
CO5	Understand the importance of transport of substances across the cell membrane								3			3		3	2	1

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318BMT04	SENSORS AND MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- Know the principle and working of displacement, pressure and temperature sensors and study its biomedical applications.
- Know the principle and working of photo electric and Piezo electric sensors and its applications.
- Analyze the different types of signal conditioning element and signal analyzers.
- Know the different display and recording devices.

UNIT I   SCIENCE OF MEASUREMENTS   9

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

UNIT II   DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS   9

Strain Gauge: Gauge factor, sensing elements, configuration, unbounded strain gage, biomedical applications; strain gauge as displacement & pressure transducers: force summing devices, capacitive transducer, inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, biomedical applications of Temperature sensors- Measurement of flow. Active type: Thermocouple – characteristics.

UNIT III   PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS   9

Phototube, Photo Multiplier Tube (PMT), photovoltaic, photoconductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectro-photometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer, Smart sensors.

UNIT IV   SIGNAL CONDITIONING & SIGNAL ANALYSER   9

AC and DC Bridges –wheat stone bridge, Kelvin, Maxwell, Hay, Schering -Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer.

UNIT V   DISPLAY AND RECORDING DEVICES   9

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, LED monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, X–Y recorder, thermal recorder.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the purpose and methods of measurements
CO2: Understand the principle of displacement, pressure and temperature sensors
CO3: Understand the working of photo electric and Piezo electric sensors

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CO4: Design different types of signal conditioners and analyzers.

CO5: Analyze the different display and recording devices for various applications.

TEXT BOOKS:

1. A.K.Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co., 19th edition, 2014.
2. Albert D.Helfrick and William D. Cooper., "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2nd edition, 2008.
3. L.A Geddas and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and sons, 3rd edition, 1991.

REFERENCE BOOKS

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Third Edition, Tata McGraw-Hill, New Delhi, 2014.
2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2009.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Describe the purpose and methods of measurements	2	3	3	2		3				2		2	3	3	3
CO2	Understand the principle of displacement, pressure and temperature sensors	2	3	3	2		3				2		2	3	3	3
CO3	Understand the working of photo electric and Piezo electric sensors	2	2	2	2		3				2		2	3	3	3
CO4	Design different types of signal conditioners and analyzers.	2	2	2			3				2		2	3	3	3
CO5	Analyze the different display and recording devices for various applications.	2	2	2	2		3				2		2	3	3	3

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COURSE OBJECTIVES:
- To study the principles of light, sound and ultrasound and its properties and about the non-ionizing radiation and their effects.
- To study various types of spontaneous radioactive emissions and various methods of producing radionuclides.
- To study various types of interaction of charged particles with matter and effects due to interaction of gamma radiation with matter.
- To study about the mechanical characteristics of lungs and cardiopulmonary system and application of Bernoulli's principle to cardiovascular system.
- To study the various types of acute and delayed effects of radiation and the various organs affected due to the radiation

UNIT I   LIGHT, SOUND AND NON-IONIZING RADIATION   9

Electromagnetic spectrum and its medical application Light - Physics of light, Intensity of light, limits of Vision and color vision Sound -Physics of sound , Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) – Interaction of Ultrasound with Materials- Reflection and Refraction – Absorption and Scattering. Non- ionizing Electromagnetic Radiation Tissue as a leaky dielectric – Relaxation Processes – Overview of non – ionizing radiation effects -Low Frequency Effect – Higher frequency effect.

UNIT II   NUCLEAR PHYSICS   9
Radioactive Decay – Spontaneous Emission – Isometric Transition - Gamma ray emission, alpha, beta, positron decay, electron capture. Principles of Nuclear Physics – Natural radioactivity, Decay series, Half life period, type of radiation and their applications. Production of radio nuclides – Cyclotron produced Radionuclide - Reactor produced Radionuclide – fission and electron Capture reaction, Radionuclide Generator – Milking Process - Linear accelerator, Radionuclide used in Medicine and technology.

UNIT III   INTERACTION OF RADIATION WITH MATTER   9

Interaction of charged particles with matter – Specific ionization , linear energy Transfer Range, Bremsstrahlung , Annihilation Interaction of Gamma radiations with matter – Photoelectric effect, Compton Scattering , pair Production, Attenuation of Gamma Radiation, Interaction of neuron with matter

UNIT IV   PHYSICS OF CARDIOPULMONARY SYSTEM   9

The Airways, - blood and lung interaction – measurement of lung volume – pressure air flow volume relation ships of lungs – physics of alveoli – the breathing mechanism – Major components of cardiovascular system – O_2 and CO_2 exchange in the capillary system – Physical activity of heart – transmural pressure – Bernolli's principles applied to cardiovascular system - Blood flow – laminar and turbulent

Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous system syndrome - Gastro-intestinal syndrome –Bone Marrow syndrome. Delayed Effects of Radiation - Stochastic and Deterministic effects – Late Deterministic effect in different organs and tissues.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Study the principles of light, sound and ultrasound and its properties and about the non-ionizing radiation and their effects

CO2: Understand the various types of spontaneous radioactive emissions and various methods of producing radionuclides.

CO3: Understand the various types of interaction of charged particles with matter and the effects due to interaction of gamma radiation with matter and their characteristics

CO4: Study about the mechanical characteristics of lungs and cardiopulmonary system and application of Bernoulli's principle to cardiovascular system

CO5: Understand the various radiation effects on human body

TEXT BOOKS:

1. B.H Brown, PV Law ford, R H Small wood , D R Hose , D C Barber , "Medical Physics and Biomedical Engineering", Taylor & Francis, 1999.
2. Gopal B.Saha "Physics and Radiobiology of Nuclear Medicine" Springer, 4th edition, 2012.

REFERENCE BOOKS:

1. John R. Cameron and James G. Skofronick, "Medical Physics", John–Wiley & Sons, 1992.
2. P.Uma Devi, A. Nagarathnam, B S Satish Rao, "Introduction to Radiation Biology" B.I.Churchill Livingstone Pvt ltd, 2000.

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COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Study the principles of light, sound and ultrasound and its properties and about the non-ionizing radiation and their effects	3			1		2				2				2	1
CO2	Understand the various types of spontaneous radioactive emissions and various methods of producing radionuclides.	3			1									2	1	
CO3	Understand the various types of interaction of charged particles with matter and the effects due to interaction of gamma radiation with matter and their characteristics	3		2	1								2	2	1	2
CO4	Study about the mechanical characteristics of lungs and cardiopulmonary system and application of Bernoulli's principle to cardiovascular system	3			1									2	1	2
CO5	Understand the various radiation effects on human body	3			1										2	1

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COURSE OBJECTIVES:

- Familiarize the basic programming concepts in C.
- Solve real time problems using functions, structure and union.
- Impart the basic concepts of linear data structures.
- Solve problem using nonlinear data structures.
- Identity the various Sorting, Searching and hashing algorithms.

UNIT I   C PROGRAMMING BASICS   9

Structure of a C program - compilation and linking processes - Constants, Variables – Data Types - Expressions using operators in C - Managing Input and Output operations - Decision Making and Branching - Looping statements. Arrays - Initialization - Declaration - One dimensional and Two-dimensional arrays. Strings - String operations - String Arrays.

UNIT II   FUNCTIONS, POINTERS, STRUCTURES AND UNIONS   9

Functions - Pass by value - Pass by reference - Recursion - Pointers - Initialization - Pointers arithmetic. Structures and unions - Structure within a structure - Union - Files- Operations on Files- Memory Management

UNIT III   LINEAR DATA STRUCTURES   9

Abstract Data Types - Linked list Implementation of List- polynomial addition- Linked List Implementation of Stack- Balancing Symbols - Postfix Expressions - Infix to Postfix Conversion - Linked list Implementation of Queues- Circular Queue

UNIT IV   NON LINEAR DATA STRUCTURES   9

Preliminaries -Binary Trees -Tree Traversals - Binary Search Tree -Operations on Binary Search Tree - Heaps - Binary Heaps - Operations of Heaps - Graph and its representations -Graph Traversals - Shortest Path Algorithm: Dijkstra's Algorithm- Minimum Spanning Tree:Prim's Algorithm – Kruskal's Algorithm.

UNITV   SEARCHING, SORTING AND HASHING   9

Linear Search - Binary Search -Bubble Sort - Insertion Sort - Quick Sort - Merge Sort - Hash Functions - Separate Chaining -Open Addressing

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Summarize the basic concepts of C

CO2: Develop programs for real time application using functions, structures, union

CO3: Gain knowledge on operations of linear data structures

CO4: Develop applications using nonlinear data structures

CO5: Apply appropriate sorting, searching technique for given problem.

TEXT BOOKS:

1. Ashok.N. Kamthane,- "Computer Programming" , Pearson Education, Second edition(India), 2012
2. Mark Allen Weiss, "Data Structures And Algorithm Analysis In C", Second Edition, Pearson Education,

REFERENCE BOOKS:

1. PradipDey and Manas Ghosh, —Programming in C, Second Edition, Oxford University Press, 2011.
2. E.Balagurusamy, - "Computing fundamentals and C Programming", Tata McGraw-Hill
3. Publishing Company Limited, 2008.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Summarize the basic concepts of C			3	2							3			2	1
CO2	Develop programs for real time application using functions, structures, union			3	2	3						2			2	1
CO3	Gain knowledge on operations of linear data structures			3	2	3						3			2	1
CO4	Develop applications using nonlinear data structures					3						3			2	1
CO5	Apply appropriate sorting, searching technique for given problem					3									2	1

318BMP07	HUMAN ANATOMY AND PHYSIOLOGY LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:
- To estimate and quantify the blood cells
- To learn methods for identification of blood groups
- To estimate hematological parameters
- To learn visual and hearing test

LIST OF EXPERIMENTS:

1. Blood grouping.
2. Bleeding time/ clotting time.
3. Estimation of Hemoglobin
4. Total RBC Count
5. Estimation of differential count
6. Estimation of ESR
7. PCV, MCH, MCV, MCHC
8. Hearing test – Tuning fork
9. Visual Activity – Snellen's Chart
10. Ishihara chart for color blindness
11. Study of Compound microscope

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Demonstrate the contents of blood and how to analyze it
CO2: Estimation of hematological parameters
CO3: Analysis of special sensory organs test

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Demonstrate the contents of blood and how to analyze it	3		2	3					1				3	3	1
CO2	Estimation of hematological parameters	3		2	3					1				3	3	1
CO3	Analysis of special sensory organs test	3		2	3					1				3	3	2

318BMP08	SENSORS AND MEASUREMENTS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:
- Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.
- Design the signal conditioning elements

LIST OF EXPERIMENTS:
1. Calibration of voltmeter using shunt type Potentiometer
2. Calibration of Ammeter using shunt type Potentiometer
3. Characteristics of thermistor
4. Characteristics of thermocouple
5. Characteristics of LDR
6. Characteristics of Photo Diode
7. Characteristics of Photo transistor
8. Characteristics of RTD
9. Characteristics of LVDT
10. Measurement of unknown Resistance using Kelvin Double Bridge
11. Measurement of unknownCapacitance using Schering Bridge
12. Measurement of unknownResistance using Wheatstone bridge
13. Step response of Hall effect transducer
14. Characteristics of strain gauge
15. Study of Smart sensors

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Describe the purpose and methods of measurements
CO2: Design and analyze different type of transducers and study its biomedical applications
CO3: Design the signal conditioning elements

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Describe the purpose and methods of measurements	1	2	2	1									2	3	1
CO2	Design and analyze different type of transducers and study its biomedical applications	1	2	2	1									2	3	1
CO3	Design the signal conditioning elements	1	2	2	1									2	3	1

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318BMP09	FUNDAMENTALS OF DATA STRUCTURES IN C LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- Understand and implement basic data structures using C
- Apply linear and non-linear data structures in problem solving
- Learn to implement functions and recursive functions by means of data structures
- Implement searching and sorting algorithms.

LIST OF EXERCISES:

1. Basic C Programs – Looping, Decision- Making
2. Programming using Arrays and String functions
3. Programming using Functions and Recursion
4. Programs using Structures and Union
5. Program using Pointers
6. Program using Memory Management Functions
7. Linked list implementation of List ,Stacks and Queues
8. Implementation of Tree Traversals
9. Implementation of Binary Search trees
10. Implementation of Graph Traversals
11. Implementation of Shortest Path Algorithm
12. Implementation of Linear search and binary search
13. Implementation of Insertion sort, Quick sort and Merge Sort

COURSE OUTCOMES:

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

CO1: Implement basic and advanced programs in C

CO2: Implement functions and recursive functions in C

CO3: Apply the different Linear Data Structures for Implementing Solutions to Practical Problems.

CO4: Apply and implement Graph Data Structures for Real Time Applications.

CO5: Implement various Searching, Sorting and hashing Algorithms.

LIST OF EQUIPMENTS AND SOFTWARE FOR A BATCH OF 30 STUDENTS

Hardware:

LAN System with 30 Nodes (OR) Stand-alone PCs -30 No's.

Printer – 3 No's.

Software:

OS: Windows

Turbo C

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	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Implement basic and advanced programs in C			3						3					2	1
CO2	Implement functions and recursive functions in C			3		3				2					2	1
CO3	Apply the different Linear Data Structures for Implementing Solutions to Practical Problems.			3		3				3					2	1
CO4	Apply and implement Graph Data Structures for Real Time Applications.					3				3					2	1
CO5	Implement various Searching, Sorting and hashing Algorithms					3									2	

COURSE OBJECTIVES:

- To learn about different applications of diodes and different biasing techniques for BJT and FET.
- To study the basic concept of feedback amplifiers & Current and voltage sources
- To acquire the knowledge about the characteristics and operation of operational amplifier
- To design the active filters and oscillators
- To learn the applications of Timer, PLL and converters.

UNIT I DIODE APPLICATIONS AND TRANSISTOR BIASING 9

Rectifiers – HWR, FWR, Bridge rectifier, Transistor operating point– Fixed bias circuit - Emitter stabilized bias Circuit – Voltage divider bias. Biasing the FET and MOSFET transistors. Review of SMD components.

UNIT II FEEDBACK AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic concept of feedback amplifiers-positive feedback, Advantages of negative feedback – voltage / current, series , Shunt feedback – stability of feedback.

UNIT III OPERATIONAL AMPLIFIER 9

The characteristics of Ideal Operation – slew rate, offset voltage, bias current, CMRR, bandwidth - equivalent circuit of an op-Amp – virtual ground concept – Linear applications– inverting and non-inverting amplifier, summing, subtracting, averaging amplifier - voltage to current converter – current to voltage converter – Differential amplifiers – differentiator and integrator. Nonlinear applications – comparator - Schmitt Triggers – Precision Diode – Average detectors – peak detector.

UNIT IV ACTIVE FILTERS AND SIGNAL GENERATOR 9

Active filters (first and second order) – Low pass, high pass, band pass filters, band reject filters (notch filters). Oscillators - RC Phase shift - Wein-bridge-Hartley-Colpitts. Waveform generators - Square, triangular and saw tooth. Case study- Biomedical Application

UNIT V TIMER, PLL, A/D AND D/A CONVERTERS 9

555 Timer (internal diagram) and its applications – Monostable multivibrator, Astable multivibrator. Phase locked Loop (565 - block diagram approach) and its applications - Frequency multiplication, Frequency translation, voltage to frequency and frequency to voltage converters. DAC – Binary weighted DAC and R-2R DAC. ADC – single slope and dual slope ADCs, successive approximation ADC-Voltage Regulators Using IC 78XX, 79XX, Three terminal fixed and adjustable voltage regulators.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design rectifiers using diode and apply suitable biasing circuits for BJT and FET.

CO2: To learnt the fundamentals feedback amplifiers & Current and voltage sources

CO3: Acquire the knowledge of inverting, non-inverting amplifier, integrator and differentiator

CO4: Get the ability to design filters and signal generator circuits according to required output.

CO5: Apply Multivibrators, Converters and regulators in circuits.

TEXT BOOKS:

1. Robert L. Boylestad, Louis Nashelsky , "Electronic Devices and circuit Theory", 11th Edition, Prentice Hall, 2013.
2. Ramakant A. Gayakwad , "OP-AMP and Linear ICs, 4th edition, Prentice Hall, 2013.
3. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.

REFERENCE BOOKS:

1. David A. Bell , Electronic Devices and Circuits 4 th Edition Prentice Hall of India, 2003.
2. MillmanHaykins, Electronic Devices And Circuits,2nd Edition Tata MC Graw Hill,2007.
3. Robert B.Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, CRC Press, 2004.
4. Sergio Franco, Design with Operational Amplifiers and analog Integrated circuits, 3rd edition, McGraw-Hills, 2002.
5. Millman, J. Halkis.C.C "Integrated Electronics".McGraw Hill, 2001.
6. Roy Choudhury, Shail B Jain, "Linear Integrated Circuits", New age International publishers, New Delhi, 2008.

E-REFERENCES:

1. http://nptel.ac.in/courses/108106068/
2. http://nptel.ac.in/courses/108106069/
3. http://nptel.ac.in/courses/117106086/

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	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Design rectifiers using diode and apply suitable biasing circuits for BJT and FET.		2				2								3	1
CO2	To learnt the fundamentals feed back amplifiers & Current and voltage sources	3	2	3	2		2				2	2	2		3	1
CO3	Acquire the knowledge of inverting, non inverting amplifier, integrator and differentiator	3	2	3	2						2	2	2	2	3	1
CO4	Get the ability to design filters and signal generator circuits according to required output.	3	2	3	2						2	2	2	2	3	1
CO5	Apply Multivibrators, Converters and regulators in circuits	3	2	3	2						2	2	2	2	3	1

	L	T	P	C
418BMT03 DIGITAL LOGIC DESIGN	3	0	0	3

COURSE OBJECTIVES:
- To study various number systems and to simplify the mathematical expressions using Boolean functions –simple problems
- To study the implementation of combinational circuits
- To study the design of sequential logic circuits.
- To get expose the students to various Programmable Logic Devices and memory.
- To study the characteristics of digital ICs and logic families

UNIT I   NUMBER SYSTEMS AND BOOLEAN ALGEBRA   9

Review of number Systems, Binary codes - BCD, Gray code, Excess 3 code, Parity, Hamming code. Boolean algebra - Basic postulates and theorems, Switching functions, Canonical forms, Logic gates- Standard representation of logic functions - Simplification of logic functions through K – maps and Quine-McClusky method.

UNIT II   COMBINATIONAL LOGIC DESIGN   9

Implementation using logic gates: Binary / BCD adders and subtractors, Magnitude comparator, Decoders, Encoders, Multiplexers and Demultiplexers. Implementation of combinational logic function using multiplexers and demultiplexers.

UNIT III   SEQUENTIAL LOGIC DESIGN   9

Introduction to Synchronous and Asynchronous Sequential circuits – Latch, Flip Flops. Mealy/Moore models – Concept of state, State diagram, State table. Design of synchronous sequential circuits – Up-down / Modulus counters, Sequence detector, Shift register: Ring counter, Johnson counter, Timing diagram.

UNIT IV   PROGRAMMABLE LOGIC DEVICES AND MEMORIES   9

Introduction to PLDs –PAL, PLA, FPGA. Implementation of digital functions using PLDs. Memories: Read only memories, PROMs, EPROMs, EEPROMs, and RAMs: Static RAM, Dynamic RAM, Double Data Rate SDRAM, Magnetic memories, CD-ROM, Flash memories

UNIT V   DIGITAL LOGIC FAMILIES   9

Characteristics of digital ICs – Voltage and current ratings, Noise margin, Propagation delay, Power dissipation, Fan-in, Fan-out. TTL, ECL MOS transistor switches –NMOS Inverter / Logic gates, CMOS Inverter / logic gates. Case studies - Biomedical Application.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of this course, students will be able to:
CO1: Compute the Postulates of Boolean algebra using different techniques
CO2: Design the Combinational circuits
CO3: Design the synchronous and asynchronous sequential circuit
CO4: Analyze the various memories and programmable logic device
CO5: Understand the concept of digital logic families

TEXT BOOKS:

1. M. Morris Mano and Michael D. Cilette, "Digital Design", Prentice Hall, Fifth Edition, 2012.
2. Thomas L Floyd, " Digital Fundamentals", Prentice Hall, 11th Edition, 2014.

REFERENCE BOOKS:

1. Tocci R J and Widmer.N S, "Digital Systems : Principles and applications" , Pearson Education Pvt. Ltd, Tenth Edition, 2011.
2. Donald D Givone, "Digital Principles and Design", Tata McGraw-Hill, 2009.
3. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall of India, Pvt Ltd, New Delhi, Second Edition, 2010.
4. Donald P Leach, Albert Paul Malvino, and GoutamSaha, "Digital Principles and applications", Tata Mcgraw Hill, Seventh Edition, 2011.

E-REFERENCES:

1. http://nptel.ac.in/courses/108106069/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/digital_circuit/frame/index.html
3. http://nptel.ac.in/courses/117106086/

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Compute the Postulates of Boolean algebra using different techniques	3	2	3	2										3	1
CO2	Design the Combinational circuits	3	2	3	2										3	1
CO3	Design the synchronous and asynchronous sequential circuit	3	2	3	2										3	1
CO4	Analyze the various memories and programmable logic device	3	2	3	2										3	1
CO5	Understand the concept of digital logic families	3	2	3	2										3	1

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COURSE OBJECTIVES:

- To gain knowledge on the structural and functional aspects of living organisms.
- To know the concept of hematological disorders.
- To know the basic concepts of microbiology.
- To understand the basic concepts of microbial diseases and microscopes.
- To gain knowledge on immune pathology

UNIT I   CELL DEGENERATION, REPAIR AND NEOPLASIA   9

Cell injury - Pathogenesis of Cell Injury -Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Inflammation- Acute Inflammation-Vascular events, Cellular Events, Chronic Inflammation- General Features of Chronic Inflammation, Healing - Regeneration and Repair Fracture Healing, Neoplasia- Classification, Benign and Malignant tumours.

UNIT II   FLUID AND HEMODYNAMIC DERANGEMENTS   9

Homeostasis-Normal water and electrolyte balance (Gibbs- Donnan Equilibrium), Disturbances of body water- Edema, Dehydration, Overhydration, Hemodynamic Derangements- Hyperaemia and Congestion, Haemorrhage, Shock, Thrombosis, Embolism, Ischaemia, Infarction,Hematological disorders- Leukaemias, Lymphomas, Bleeding disorders-Thrombocytopenia

UNIT III   FUNDAMENTALS OF MICROBIOLOGY   9

Bacterial anatomy – Shape, arrangements and structure of bacteria. Culture media and its types. Bacterial growth curve. Pure culture methods (Streak, spread and pour plate methods). Identification of bacteria. Microscopy – Bright field, phase contrast, fluorescent and electron microscopes. Staining methods – Simple, Gram, Endospore, Acid fast and capsule staining, Automated staining method.

UNIT IV   MICROBIAL DISEASES AND DIAGNOSIS   9

Infection – Source of infection, methods of transmission of infection and types of infection. Bacterial diseases – Pneumonia, tuberculosis, typhoid, cholera and syphilis. Viral diseases - Morphology of virus, viral multiplication – Hepatitis B and Rabies, Dengue. Fungal diseases – Dermatophytosis, Candidiasis; Parasitic diseases – Amoebiasis (Entamoeba histolytica), malaria (Plasmodium falciparum) and Filariasis (Wucheriria bancrofti).

UNIT V   IMMUNOPATHOLOGY & IMMUNODIAGNOSIS   9

Structure and functions of immune system – Cells of immune system, Organs of immune system. Antigens & Antibodies – structure, properties and types. Antigen -Antibody reactions -agglutination, precipitation, ELISA, Immuno flourescence and RIA. Hypersensitivity. Autoimmunity – Graves disease, Good Pasteure's syndrome, Rheumatoid arthritis and Systemic Lupus Erythmatous (SLE) and treatment. Immunodeficiency and HIV.

TOTAL HOURS: 45 PERIODS

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Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

COURSE OUTCOMES:

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

CO1: Analyze Pathogenesis of Cell injury and Inflammation

CO2: Explain the concept of homeostasis, Haemorrhage and hematological disorders.

CO3: Discuss the basic concepts of Bacterial anatomy, Staining methods and Microscopy.

CO4: Describe the concepts on various infection and microbial diseases.

CO5: Gain the knowledge on immune system, antigen-antibody reactions

TEXT BOOKS:

1. Ananthanarayanan & Panicker, Text book of Microbiology, Orient black swan, 10th edition, 2017.
2. Dr.Ajoy Paul, Text book of Immunology, Books & Allied (P) Ltd, 2015.

REFERENCE BOOKS:

1. Dubey RC and Maheswari DK., A Text Book of Microbiology, Chand & Company Ltd, 2007
2. Prescott, Harley and Klein, Microbiology, 10th edition, McGraw Hill, 2017

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze Pathogenesis of Cell injury and Inflammation	3	3	3			1							3	2	1
CO2	Explain the concept of homeostasis, Haemorrhage and hematological disorders.		3				2		2		2	2		3	2	1
CO3	Discuss the basic concepts of Bacterial anatomy, Staining methods and Microscopy.	3					1			2			2	3	2	1
CO4	Describe the concepts on various infection and microbial diseases.		3				2		2		2	2		3	2	1
CO5	Gain the knowledge on immune system, antigen-antibody reactions	3	2				1							3	1	1

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418BMT05	BIOCHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain basic knowledge on biomolecules
- To have a sound knowledge on classification, structure and properties of carbohydrates, lipids and amino acids and their functions
- To know about the overview of central metabolic pathways, the classification of enzymes and their general effects and regulation.
- To emphasize the role of these biomolecules by providing basic information on specific metabolic diseases and disorders of these biomolecules
- To Know Clinical applications of Biochemistry

UNIT I   INTRODUCTION TO BIOCHEMISTRY   9

Biochemistry and the living state, Introduction to Biomolecules, Energy transformation in living organism. Chemical reactions in living cells, Water- Physical properties and hydrogen bonding, Solvent properties, pH, Acid and bases, buffers

UNIT II   CARBOHYDRATES   9

Classification of carbohydrates - mono, di, and polysaccharides. Structure, physical and chemical properties of carbohydrates, Digestion and absorption of carbohydrates, Metabolisms of carbohydrates – Glycolysis-Reactions of glycolysis, Pasteur effect, Citric acid cycle, glycogenesis, glycogenolysis, Biological oxidation-electron transport chain. Oxidative phosphorylation. Biochemical aspect of Diabetes mellitus and Glycogen storage disease.

UNIT III   LIPIDS   9

Lipids-Classification and Functions, Nomenclature of fatty acid, Triacylglycerols - Properties of triacylglycerol, Lipoproteins- Structure and classification, Metabolism of lipids- Fatty acid oxidation (beta oxidation), ketogenesis, Cholesterol biosynthesis. Disorders of lipid metabolism- Obesity, Atherosclerosis.

UNIT IV   NUCLEIC ACID & PROTEIN   9

Nucleic acids- Structure and functions of Nucleotides, Structure of DNA-DNA double helix, Structure of RNA and its type. Metabolism of nucleotide-Biosynthesis of purine ribonucleotides, Disorders of purine metabolism, Biosynthesis of pyrimidine ribonucleotides, Proteins-Structure, properties and classification of proteins, Structure, Classification and Properties of amino acids, Inborn errors of amino acid metabolism

UNIT V   ENZYME AND ITS CLINICAL APPLICATIONS   9

Nomenclature and Classification of enzymes, Chemical nature and properties, Factors affecting enzyme activity, Enzyme inhibition, Enzyme specificity, Coenzymes, Mechanism of enzyme action, Regulation of enzyme activity in the living system, Clinical applications of enzymes

                                                        TOTAL HOURS: 45 PERIODS

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COURSE OUTCOMES:

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

CO1: Explain the fundamentals of biochemistry

CO2: Gain knowledge on classification, structure and properties of carbohydrates and its metabolic pathways

CO3: Understand the properties of Lipids and disorders of lipid metabolism

CO4: Gain knowledge on structure of DNA, RNA and Proteins

CO5: Know about the overview of the classification of enzymes, their general effects and regulation

TEXT BOOKS:

1. Satyanarayana U., Chakrapani U., "Biochemistry", Elsevier, 4th edition, 2013.
2. Albert L. Lehninger , "Principles of Biochemistry", W. H. Freeman publication, 7th edition,2017.

REFERENCE BOOKS:

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. Pamela.C.Champe & Richard.A.Harvey, "Lippincott Biochemistry Lippincott's Illustrated Reviews", Raven publishers, 2005.

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Explain the fundamentals of biochemistry	3	2				2							3	1	1
CO2	Gain knowledge on classification, structure and properties of carbohydrates and its metabolic pathways	3	2		1		1							3	1	1
CO3	Understand the properties of Lipids and disorders of lipid metabolism	3	2		1		1							3	1	1
CO4	Gain knowledge on structure of DNA, RNA and Proteins	3	2		1		1							3	1	1
CO5	Know about the overview of the classification of enzymes, their general effects and regulation	3	2		1		1							3	1	1

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

- To understand the classification of signals and systems
- To analyze the CT periodic and aperiodic signals using CT Fourier and Laplace transform methods.
- To understand the characterization of total response, impulse response and frequency response of LTI CT systems.
- To find the discrete Time Fourier Transforms and Z transform for the discrete time signals.
- To acquire the knowledge in LTI DT systems.

UNIT I   CLASSIFICATION OF SIGNALS AND SYSTEMS   9

Continuous Time signals (CT signals), Discrete Time signals (DT signals) - Step, Ramp, Impulse, Exponential, Classification of CT and DT signals - periodic and aperiodic, Energy and power, even and odd, Deterministic and Random signals, Transformation on Independent variables -CT systems and DT systems, Properties of Systems – Linearity, Causality, Time Invariance, Stability, Invertibility and LTI Systems.

UNIT II   ANALYSIS OF CT SIGNALS   9

Fourier Series Analysis, Continuous Time Fourier Transform and Laplace Transform in Signal Analysis, Properties of Fourier Transform, Laplace Transform-Properties-ROC, Parseval's Theorem, Sampling Theorem and Aliasing.

UNIT III   LTI-CT SYSTEMS   9

Differential equations-Total Response- Fourier Transform & Laplace Transform, Impulse response, Convolution Integral, Frequency response.

UNIT IV   ANALYSIS OF DT SIGNALS   9

Discrete Time Fourier Transform (DTFT), Z-Transform in signal analysis, Z-transform-Properties-ROC and Inverse Z Transform-Partial Fraction-Long Division.

UNIT V   LTI-DT SYSTEMS   9

Difference equations, Total Response-Z- Transform, Impulse response, Convolution sum, Frequency response

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Categorize the properties and representation of discrete and continuous time signals.
CO2: Analyze the continuous time signal using Fourier and Laplace transform.
CO3: Determine total response, impulse response and frequency response of LTI-CT systems
CO4: Analyze the discrete time signals using Discrete Time Fourier Transforms and Z transform
CO5: Determine total response, impulse response and frequency response by using differential equations of LTI-DT Systems

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TEXT BOOKS:

1. Allan V. Oppenheim, Alan S.Willsky with S.Hamid Nawab, "Signals and Systems", 2nd edn. Pearson Education, 2015.
2. M.J.Roberts, Signals and Systems Analysis using Transform method and MATLAB, TMH 2012.

REFERENCE BOOKS:

1. Lathi B.P, Signals Systems & Communications, B S Publications, Hyderabad, 2008.
2. Simon Haykin and Barry Van Veen, "Signals and Systems", John Willey, 2007
3. K.Lindner, "Signals and Systems", McGraw Hill International, 1999
4. Michael J Roberts, "Fundamentals of Signals and Systems" Tata McGraw Hill, 2007.
5. Moman H. Hays, "Digital Signal Processing", Schaum's outlines, Tata McGraw Hill Co Ltd., 2004.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Categorize the properties and representation of discrete and continuous time signals.	3	3	1	2									1	3	1
CO2	Analyze the continuous time signal using Fourier and Laplace transform	3	3	1	2									1	3	1
CO3	Determine total response, impulse response and frequency response of LTI-CT systems	3	3	1	2									1	3	1
CO4	Analyze the discrete time signals using Discrete Time Fourier Transforms and Z transform	3	3	1	2									1	3	1
CO5	Determine total response, impulse response and frequency response by using differential equations of LTI-DT Systems	3	3	1	2									1	3	1

COURSE OBJECTIVES:

- To enhance the students about the areas where the simple electronic components are being used
- To acquire the knowledge about the characteristics and operation of analog IC 741
- To design filter circuits, oscillators and wave form generators using op amp.
- To design the adder , encoder and decoder using logic gates
- To enhance the knowledge in shift register and counters

LIST OF EXPERIMENTS

1. Rectifiers – HWR and FWR (with & without capacitor filter)
2. Zener diode as regulator
3. FET amplifier
4. Inverting, non-inverting amplifier and comparator
5. Integrator and Differentiator.
6. Active filter – first order LPF and HPF
7. Schmitt trigger using IC741
8. Wein bridge oscillator
9. Multivibrator using IC555 Timer
10. Study of logic gates, Half adder and Full adder
11. Encoder and BCD to 7 segment decoder
12. Multiplexer and demultiplexer using digital ICs
13. Universal shift register using flip flops
14. Design of mod-N counter

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the practical application of various electronic circuits like rectifiers and Regulators
CO2: Acquire the designing knowledge of linear and non-linear applications of IC 741
CO3: Gain knowledge in design of filter circuits, oscillators and wave form generators.
CO4: Design the adder, encoder and decoder using logic gates
CO5: Understand the design concept in shift register and counters

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COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the practical application of various electronic circuits like rectifiers and Regulators	3	3	3	3										3	2
CO2	Acquire the designing knowledge of linear and non-linear applications of IC 741	3	3	3	3										3	2
CO3	Gain knowledge in design of filter circuits, oscillators and wave form generators	3	3	3	3										3	2
CO4	Design the adder, encoder and decoder using logic gates	3	3	3	3										3	2
CO5	Understand the design concept in shift register and counters															

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COURSE OBJECTIVES:
- To practice various staining techniques
- To perform histopathological examinations
- To Diagnose typhoid fever using widal test

LIST OF EXPERIMENTS
1. Simple staining
2. Gram staining
3. Acid fast staining
4. Endospore staining
5. Capsule staining
6. Widal slide test
7. Rapid Plasma Reagin Test (RPR Test)
8. Counter Immuno Electrophoresis (CIE)
9. Slides of Plasmodium, Microfilaria and Entamoeba histolytica
10. Histopathological slides of benign and malignant tumours.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Practice various staining methods
CO2: Diagnose typhoid fever using widal test
CO3: Perform histopathological examinations

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Practice various staining methods		2	2		2			2	2				2	2	
CO2	Diagnose typhoid fever using widal test		2	2		2			2	2				2	2	
CO3	Perform histopathological examinations		2	2		2			2	2				2	2	

COURSE OBJECTIVES:
- To learn the laboratory analysis of carbohydrates, lipids and proteins qualitatively and quantitatively
- To provide basic training in biochemical techniques such as chromatography and electrophoresis

LIST OF EXPERIMENTS:
1. Qualitative analysis of carbohydrates
   i), Glucose ii) Fructose iii) Lactose iv) Sucrose
2. Qualitative analysis of proteins
   i) Casein ii) Albumin
3. Qualitative analysis of lipids
4. Preparation of serum and plasma from blood.
5. Estimation of blood glucose.
6. Estimation of serum cholesterol.
7. Estimation of serum protein
8. Assay of serum marker enzymes
   i) Determination of activity of SGOT
   ii) Determination of activity of SGPT
9. Estimation of creatinine in urine.
10. Separation of amino acids using paper chromatography.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of this course, students will be able to:
CO1: Demonstrate a qualitative and quantitative understanding of major biomolecules such as carbohydrates, lipids and proteins
CO2: Recognize and explain the basic features of chromatography and electrophoresis

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Demonstrate a qualitative and quantitative understanding of major biomolecules such as carbohydrates, lipids and proteins	3	3	2					3					2	2	3
CO2	Recognize and explain the basic features of chromatography and electrophoresis	3	3	2	3				3					2	1	3

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518BMT01	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- Understand the origin of biopotentials & different types of electrodes used in biopotential recording
- Know the different lead configurations used for recording biosignals like ECG, EEG, EMG, ERG & EOG.
- Understand the need for bioamplifiers and different types of bioamplifiers.
- Know the instrumentation concerned with measuring the non electrical parameters.
- Know the chemical sensors and analyzers.

UNIT I   BIO POTENTIAL ELECTRODES   9

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. Recording problems - measurement with two electrodes.

UNIT II   BIOPOTENTIAL RECORDING   9

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. Electrogastrogram, Electroneurogram

UNIT III   BIO AMPLIFIERS   9

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier, Trans-impedance amplifier, Power line interference.

UNIT IV   MEASUREMENT OF NON-ELECTRICAL PARAMETERS   9

Temperature, respiration rate and pulse rate measurements, Audiometer. 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   9

Biochemical sensors - pH, pO_2 and pCo_2, Ion selective Field Effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, Colorimeter, Flame photometer, Spectrophotometer, Densitometer, Blood cell counter, Auto analyzer (simplified schematic description).

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Gain knowledge about various biopotential Electrodes and its effects
CO2: Learn the different types of electrodes used to record ECG, EEG, EMG.ERG, and EOG with lead configuration.
CO3: Gain knowledge about the need for various bioamplifiers and isolation amplifiers.
CO4: Learn the instrumentation concerned with measuring the blood pressure, Temperature, Respiration rate.
CO5: Know the biochemical sensors and blood gas analyzers.

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TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. John G. Webster, "Medical Instrumentation Application and Design", Fourth Edition, John Wiley and sons, New York, 2009

REFERENCE BOOKS:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Third Edition, Tata McGraw-Hill, New Delhi, 2014.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design" , McGraw-Hill Publisher, 2003.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Gain knowledge about various biopotential Electrodes and its effects	3		3	2								1	1	3	1
CO2	Learn the different types of electrodes used to record ECG, EEG, EMG.ERG, and EOG with lead configuration	3		3	2									2	3	1
CO3	Gain knowledge about the need for various bioamplifiers and isolation amplifiers	3		3	2	1								2	3	1
CO4	Learn the instrumentation concerned with measuring the blood pressure, Temperature, Respiration rate	3		3	2	1						1			2	1
CO5	Know the biochemical sensors and blood gas analyzers	3		3	2	1									3	1

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                                                                                                 3   0   0   3

COURSE OBJECTIVES:
- Compute FFT of a discrete time signal.
- Design the various FIR filter techniques.
- Design the various IIR filter techniques.
- Analyze the finite word length effects in signal processing.
- Learn the fundamentals of digital signal processors.

UNIT I   **FAST FOURIER TRANSFORM AND CONVOLUTION**   **9**

Introduction to DFT – Efficient computation of DFT- Properties of DFT – FFT algorithms – Radix-2 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms –Fast convolution- overlap save method-overlap add method. Case study - Biomedical Applications of DSP.

UNIT II   **FINITE IMPULSE RESPONSE DIGITAL FILTERS**   **9**

Linear phase filters-Frequency response of linear phase FIR filters-Fourier series method of designing FIR filters-Windowing techniques for design of linear phase FIR filters: Rectangular- Hamming-Hanning-Blackman and Kaiser Windows. Gibbs phenomenon –principle of frequency sampling technique- Realization - FIR filters-Direct form, Cascade realization, Linear phase FIR realization. Case study- FIR filters in a hearing aid.

UNIT III   **INFINITE IMPULSE RESPONSE DIGITAL FILTERS**   **9**

Review of design of analogue Butterworth and Chebyshev Filters- Frequency transformation in analog domain – Design of IIR digital filters using impulse invariance technique –bilinear transformation – pre warping –Frequency transformation in digital domain – Realization - Direct form I, Direct form II, cascade and parallel. Case study- IIR filters to extract alpha activity from EEG signal.

UNIT IV   **FINITE WORD LENGTH EFFECTS**   **9**

Quantization noise – truncation and rounding error-derivation for quantization noise power – Binary fixed point and floating point number representations – Comparison – input quantization error-coefficient quantization error –Product quantization error-limit cycle oscillations-dead band-Overflow error-signal scaling.

UNIT V   **DIGITAL SIGNAL PROCESSOR TMS320C54X**   **9**

Introduction-Architecture of C54X – 'C54X buses-Internal memory organization-Central Processing unit-Arithmetic Logic unit-Barrel Shifter-Multiplier/Adder unit-Compare, select and store unit-On-chip Peripherals-External Bus Interface - Overview of instruction set –Data addressing 'C54X-Arithmetic instructions-Data Transfer instructions-Logical instructions.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Compute FFT of a discrete time signal.
CO2: Design the various FIR filter techniques.
CO3: Design the various IIR filter techniques.
CO4: Analyze the finite word length effects in signal processing.
CO5: Learn the fundamentals of digital signal processors.

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TEXT BOOKS:

1. John G Proakis- Dimtris G Manolakis- Digital Signal Processing Principles-Algorithms and Application- Pearson/PHI- 4th Edition- 2007
2. S.K.Mitra- "Digital Signal Processing- A Computer based approach"- TataMcGraw-Hill- 1998- New Delhi.
3. B.Venkataramani& M-Bhaskar- Digital Signal Processor Architecture-Programming and Application- TMH 2002.

REFERENCE BOOKS:

1. Allan V.Openheim, Ronald W.Sehafer& John R.Buck-"Discrete Time Signal Processing", Third edition-Pearson/Prentice Hall, 2014.
2. Johny R-Johnson: Introduction to Digital Signal Processing- Prentice Hall- 1984.
3. Emmanuel I feachor "Digital Signal Processing: A Practical Approach", Second edition - Prentice Hall
4. Li Tan " Digital Signal Processing" Elsevier-2008

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Compute FFT of a discrete time signal	3	3		3	2									3	1	
CO2	Design the various FIR filter techniques	3	3		3	2									3	1	
CO3	Design the various IIR filter techniques	3	3		3	2									3	1	
CO4	Analyze the finite word length effects in signal processing	2	2		3	2									2	1	
CO5	Learn the fundamentals of digital signal processors	3	3		3	2									2	1	

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		MICROPROCESSOR AND MICROCONTROLLER	**L**	**T**	**P**	**C**
		SYSTEM DESIGN	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:
- Understand the architecture and assembly language programming of microprocessors
- Understand the architecture and assembly language programming of microcontrollers
- Learn the concept of interrupts.
- Learn about interfacing the microcontroller with real time applications.
- Understand the architectural features of PIC

UNIT I   8085 MICROPROCESSOR   9
8085 Architecture – Instruction set – Addressing modes – Timing diagrams – Assembly language programming – Interrupts.

UNIT II   8086 MICROPROCESSOR AND PERIPHERAL INTERFACING   9
Intel 8086 Internal Architecture – 8086 Addressing modes- Instruction set- 8086 Assembly language Programming-Interrupts - Interrupt service routine-Serial I/O (8251)- parallel I/O (8255) –Keyboard and Display controller (8279).

UNIT III   8051 MICROCONTROLLER   9
8051 Internal Architecture - Ports and circuits- External memory –instruction set – Addressing modes – Assembly language programming – I/O port programming –Timer and counter programming – Serial Communication – Interrupt programming.

UNIT IV   8051 REAL WORLD INTERFACING   9
8051 Interfacing: Keyboard, LCD, Stepper Motors, Interfacing to external memory and 8255.

UNIT V   PIC16F8XX MICROCONTROLLER   9
Introduction to PIC16F8XX Flash microcontrollers: Pin diagram of 16F8XX, Architectural features, I/O Ports, & Timers, Addressing modes of 16F877-Instruction Set. AVR Microcontroller, Case study-Biomedical Applications.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of this course, students will be able to:
CO1: Understand the architecture and assembly language programming of microprocessors
CO2: Understand the architecture and assembly language programming of microcontrollers
CO3: Learn the concept of interrupts.
CO4: Learn about interfacing the microcontroller with real time applications.
CO5: Understand the architectural features of PIC

TEXT BOOKS:
1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 6th Edition, Penram International Publishing, New Delhi, 2013.
2. JohnUffenbeck, The 80x86 Family, Design, Programming and Interfacing, Third Edition. Pearson Education, 2002.
3. Mohammed Ali Mazidi and Janice GillispieMazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education Asia, New Delhi, 2003.
4. John B.Peatman, Design with PIC Microcontrollers, Pearson Education Asia, 2002.

REFERENCES:

1. A.K. Ray and K.M.Burchandi, Intel Microprocessors Architecture Programming and Interfacing, McGraw Hill International Edition, 2000
2. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, 2nd Edition, Penram International Publishers (India), New Delhi, 1996.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the architecture and assembly language programming of microprocessors	1	3	3	3	2								3	2	
CO2	Understand the architecture and assembly language programming of microcontrollers	1	3	3	3	2								3	2	
CO3	Learn the concept of interrupts.	1	3	3	3	2								3	2	
CO4	Learn about interfacing the microcontroller with real time applications	1	3	3	3	2								3	2	
CO5	Understand the architectural features of PIC	1	3	3	3									3	2	

518BMT04	BIOCONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand system concept and different mathematical techniques applied in analyzing any given system.
- Analyze a given system in time domain and frequency domain.
- Understand the techniques of plotting the responses in both domain analyses.
- Know the concept of stability and stability analysis.
- Apply time and frequency domain analysis to study the biological systems.

UNIT I   CONTROL SYSTEM MODELLING   9

Terminology and basic structure of control system, example of a closed loop system, transfer functions, modeling of electrical systems, translational and rotational mechanical systems, electromechanical systems, block diagram and signal flow graph representation of systems, conversion of block diagram to signal flow graph, reduction of block diagram and signal flow graph.

UNIT II   TIME RESPONSE ANALYSIS   9

Step and Impulse responses of first order and second order systems, determination of time domain specifications of first and second order systems from its output responses, simulation, definition of steady state error constants and its computation, Response with P,PI,PD and PID controllers.

UNIT III   STABILITY ANALYSIS   9

Definition of stability, Routh-Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability .

UNIT IV   FREQUENCY RESPONSE ANALYSIS   9

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop stability, Bode plot and determination of gain margin and phase margin , Simulation of Bode plot, use of Nichol's chart to compute resonance frequency and band width.

UNIT V   PHYSIOLOGICAL CONTROL SYSTEMS   9

Block diagram representation of the muscle stretch reflex, difference between engineering and physiological control systems, generalized system properties, models with combination of system elements, Introduction to simulation, Case Studies.

TOTAL HOURS: 45 PERIODS

Course Outcomes:

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

CO1: Gain knowledge in modeling of mechanical, electrical system with signal flow graph and block diagram reduction Techniques.
CO2: Measure the time domain and frequency domain specifications.
CO3: Plotting the responses in time domain and frequency domain analysis for the stability criteria.
CO4: Plotting the magnitude and phase for bode plot, Nyquist plot and Nichol's Plot for measuring stability.
CO5: Learn the concept of Physiological control systems.

TEXT BOOKS:

1. M. Gopal, "Control Systems Principles and Design", Fourth Edition, Tata McGraw Hill, India,

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2014
2. Farid Golnaraghi, Benjamin C. Kuo,"Automatic control systems", Ninth Edition, Wiley, India, 2009
3. Michael C K Khoo, "Physiological control systems", IEEE press, Prentice –Hall of India, 2005.

REFERENCE BOOKS:

1. John Enderle, Joseph Bronzino "Introduction to Biomedical Engineering" Third edition, Academic Press, 2011.
2. Richard C. Dorf, Robert H. Bishop," Modern control systems", Twelfth Edition, Pearson, 2011.

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Gain knowledge in modeling of mechanical, electrical system with signal flow graph and block diagram reduction Techniques	3	3	3	3	3								2	3	1
CO2	Measure the time domain and frequency domain specifications.	3	3	3	3									1	3	1
CO3	Plotting the responses in time domain and frequency domain analysis for the stability criteria	3	3	2	3										2	1
CO4	Plotting the magnitude and phase for bode plot, Nyquist plot and Nichol's Plot for measuring stability.	3	3	3	2									2	3	1
CO5	Learn the concept of Physiological control systems.	3	3	3	3					3			3	1	3	1

COURSE OBJECTIVES:
- Understand modulation and demodulation techniques.
- Understand various pulse modulation techniques.
- Acquire knowledge on different phase shift keying techniques.
- Learn the basics of coding and decoding methods.
- Know the recent trends in wireless technology.

UNIT I   ANALOG MODULATION   9
Amplitude Modulation – AM, DSBSC, SSBSC, VSB, modulators and demodulators – Angle modulation – PM and FM, modulators and demodulators – Superheterodyne receivers

UNIT II   PULSE MODULATION   9
Low pass sampling theorem – Quantisation - PAM – Line coding - PCM, DPCM, DM, ADPCM and ADM, Channel Vocoder,– Time Division Multiplexing, frequency Division Multiplexing Data compression of ECG signals using delta modulation

UNIT III   DIGITAL MODULATION AND TRANSMISSION   9
Phase shift keying – BPSK, DPSK, DEPSK(Digitally encoded PSK), QPSK - Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding - Cosine filters – Eye pattern, equalizers

UNIT IV   INFORMATION THEORY AND CODING   9
Measure of information – Entropy – Source coding theorem - Shannon-Fano coding, Huffman Coding, LZ Coding– Channel capacity – Shannon-Hartley law – Shannon's limit- Error control Codes – Cyclic codes, Syndrome calculation – Convolutional Coding, Sequential and Viterbi coding and decoding.

UNIT V   WIRELESS COMMUNICATION SYSTEMS   9
Commercial Cellular / 3G networks, Overview of SATCOM, SOTM, wireless sensor networks, wireless personal area networks : Body LAN-Bluetooth, Zigbee-Wireless LANs, Internet-Wifi-WiMax, Case studies: IEEE 802.11A Wireless LAN Standard,4G,5G networks. Wireless patient monitoring system (WPM)

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Understand modulation and demodulation techniques.
CO2: Understand various pulse modulation techniques.
CO3: Acquire knowledge on different phase shift keying techniques.
CO4: Learn the basics of coding and decoding methods.
CO5: Know the recent trends in wireless technology.

TEXT BOOKS:
1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" Fourth Edition, Tata McGraw Hill, India, 2013
2. S. Haykin "Digital Communication Systems", First Edition, John Wiley, 2013
3. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2012

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REFERENCE BOOKS:
1. B.P.Lathi, "Modern Digital and Analog Communication Systems", Fourth Edition, Oxford University Press, 2011
2. H P Hsu, "Analog and Digital Communications", Third Edition, Schaum Outline Series - Tata McGraw Hill, 2009
3. B.Sklar, "Digital Communications Fundamentals and Applications" , Second Edition, Pearson Education 2007

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand modulation and demodulation techniques	3			2					3				2		2
CO2	Understand various pulse modulation techniques	3		2				2				2		2		
CO3	Acquire knowledge on different phase shift keying techniques	3	2		2		2			3				3		2
CO4	Learn the basics of coding and decoding methods		2		2			2			3			2		
CO5	Know the recent trends in wireless technology		3	2	2			2			3			2		

                                                                      3   0   0   3

COURSE OBJECTIVES:

- To study the virtual instrumentation introduction.
- To familiarize the LabVIEW environment.
- To understand the programming techniques in VI.
- To study the DAQ hardware.
- To study the VI applications and learn to implement small projects in VI.

UNIT I   INTRODUCTION   9
Graphical System Design Model- Design Flow with GSD- Virtual Instrumentation and Lab VIEW–
Virtual Instrument Verses Traditional Instrument – Architecture of Virtual Instrumentation-
Hardware and software in virtualInstrumentation- Virtual Instrumentation for test , Control and Design-
Virtual Instrumentation in the Engineering

UNIT II   LabVIEW ENVIRONMENT   9
Front panel-Block diagram-Icon and Connector – Control Palette-Function Palette-Tools Palette-Creating,
editing, wiring, debugging and saving VIs - sub- VIs-creating sub-VIs-simple examples-Looping: For loop,
while loop-Shift registers- case and sequence; structures, formula nodes

UNIT III   PROGRAMMING TECHNIQUES   9
Arrays-clusters, charts and graphs, local and global variables-property node, string and file I/O, Feedback
Nodes-Tables

UNIT IV   DATA ACQUISITION AND INSTRUMENT CONTROL   9
DAQ-Components-Buffers: Buffered and non-buffered I/O-Triggering-Analog I/O Digital I/O-Counters
andtimers-Instrument control: VISA, GPIB, VXI and PXI.

UNIT V   LabVIEW APPLICATIONS   9
Applications of LabVIEW: biomedical-glucose, blood pressure and ECG monitoring system, Image
acquisitionand processing. Case Study: Digital stop watch and BCD to 7segment Decoder.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Learn the virtual instrumentation fundamentals.

CO 2: Familiarize with the VI software and learn programming in VI

CO 3: Understand various programming techniques.

CO 4: Understand various Instrument Interfacing and data acquisition methods.

CO 5: Develops programs for Process control applications

TEXT BOOKS:
1. S.Sumathi, P.Surekha,' Virtual Instrumentation with LabVIEW' Acme Learning private Ltd,2011
2. Gary Johnson, 'LabVIEW graphical programming', II Ed., McGraw Hill, 1999.
3. Jovitha Jerome 'Virtual Instrumentation using LabVIEW' PH1 Learning Pvt Ltd, 2009

REFERENCE BOOKS:
1. Lisa K Wells & Jeffrey Travels, 'LabVIEW for everyone', Prentice Hall, 2003.
2. Sanjeev Gupta, 'Virtual Instrumentation using LabVIEW' Tata McGraw Hill, 2004

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COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Learn the virtual instrumentation fundamentals.	2	2	2	1	2				1			1	1		1
CO2	Familiarize with the VI software and learn programming in VI	2	2	2	1	2	1			1		2	1	1		2
CO3	Understand various programming techniques.	2	2	2	2	2				1		2	1	1		2
CO4	Understand various Instrument Interfacing and data acquisition methods.	2	2	2	1	2	1			1		2	1	1		1
CO5	Develops programs for Process control applications	2	2	2	2	2	1			1		1	1	1		2

BIO MEDICAL INSTRUMENTATION LABORATORY   L   T   P   C
                                                                    0   0   2   1

COURSE OBJECTIVES:
- Record the biosignals like ECG, EEG, EMG.
- Record the various physiological parameters.
- Measure nonelectrical parameters using the chemical sensors.
- Know about the safety aspects of surgical diathermy.

LIST OF EXPERIMENTS
1. Design of Biological Preamplifiers.
2. Recording of ECG signal and Analysis.
3. Recording of Audiogram and Analysis.
4. Recording of EMG and Analysis.
5. Recording of EEG and Analysis.
6. Measurement of Pulse rate using Photo Electric Transducer.
7. Recording of various physiological parameters using patient monitoring system
8. Measurement of pH, pO2 and conductivity.
9. Study and analysis of functioning and safety aspects of surgical diathermy.
10. Recording of Digital Blood Pressure Monitor

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Record the biosignals like ECG, EEG, EMG.
CO2: Record the various physiological parameters.
CO3: Measure nonelectrical parameters using the chemical sensors.
CO4: Know about the safety aspects of surgical diathermy.

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Record the biosignals like ECG, EEG, EMG	3	3	3		3				3			3	3	3	
CO2	Record the various physiological parameters	3	3	3		3				3			3	3	3	
CO3	Measure nonelectrical parameters using the chemical sensors	3	3	3		3				3			3	3	3	
CO4	Know about the safety aspects of surgical diathermy.	3		3		3				3			3	3	3	

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COURSE OBJECTIVES:
- Develop the code in assembly language programming.
- Test and develop code using 8085, 8086 processors and 8051 controllers.
- Demonstrate the interface peripherals with microprocessor and micro controller

LIST OF EXPERIMENTS:

   I.   **8085 based Experiments**

    1. 8-bit Arithmetic operations using 8085.

    2. 16-bit Arithmetic operations using 8085.

    3. Searching of a Largest and smallest number in an array using 8085.

    4. Sorting of an array using 8085

    5. Conversion of Hexadecimal to ASCII code using 8085

    6. Design of Simple ALU using 8085.

   II.   **8086 based Experiments**

    7. 16-bit Arithmetic operations using 8086

    8. Searching of a Largest and smallest number in an array using 8086

    9. String manipulation using 8086.

    10. Generation of Fibonacci series using 8086

   III.   **8051 based experiments**

    11. 8-bit arithmetic operations using 8051 microcontroller

    12. Design of simple ALU using 8051 microcontroller.

   IV.   **Interfacing Experiments with 8085/8086/8051**

    13. Stepper motor interfacing

    14. DAC interfacing

    15. 8253 timer

    16. Traffic light controller

    17. 8279 keyboard/display controller

COURSE OUTCOMES:

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

CO1: Develop the code in assembly language programming.

CO2: Test and develop code using 8085, 8086 processors and 8051 controllers.

CO3: Demonstrate the interface peripherals with microprocessor and micro controller

TOTAL HOURS: 45 PERIODS

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Develop the code in assembly language programming.	3	1	3	3	2						3		3	2	
CO2	Test and develop code using 8085, 8086 processors and 8051 controllers	3	1	3	3	2						3		3	2	
CO3	Demonstrate the interface peripherals with microprocessor and micro controller	3	1	3	3	2						3		3	2	

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COURSE OBJECTIVES:

- Compute FFT and IFFT of a discrete time signal.
- Design and analyze the various FIR filter techniques
- Design and analyze the various IIR filter techniques
- Demonstrate Finite word length effects
- Analyze the Biomedical signals

LIST OF EXPERIMENTS:
1. Generation of sequences (functional & random), correlation and convolution
2. Spectrum Analysis using FFT
3. Filter Design & Analysis
4. Study of Quantization errors in DSP algorithms
5. Difference equation Representation
6. Multirate Filters
7. Estimation of Power spectrum density
8. Upsampling and downsampling
9. Speech Processing
10. Analysis of ECG
11. Analysis of EEG

DSP Processor Implementation
1. Waveform Generation
2. FIR Implementation
3. IIR Implementation
4. FFT
5. Finite word Length effect
6. Multirate filters

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Compute FFT and IFFT of a discrete time signal.
CO2: Design and analyze the various FIR filter techniques
CO3: Design and analyze the various IIR filter techniques
CO4: Demonstrate Finite word length effects
CO5: Analyze the Biomedical signals

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COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Compute FFT and IFFT of a discrete time signal.	1	1		3	3					2	2		3	1	2
CO2	Design and analyze the various FIR filter techniques	1	1	2	3	3					2	2		3	1	2
CO3	Design and analyze the various IIR filter techniques	1	1	2	3	3					2	2		3	1	2
CO4	Demonstrate Finite word length effects	1	1		3	3					2	2		3	1	2
CO5	Analyze the Biomedical signals	1	1		3	3		2			2	2		3	1	2

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COURSE OBJECTIVES:
- To study the genesis and variation in ECG and EEG waveform
- To understand the concept of ultrasonic technique
- To understand about the different respiratory measurement techniques
- To analyze the use of an audiometer and the Galvanic Skin Resistance(GSR)
- To gain knowledge in patient monitoring systems and biotelemetry

UNIT I   CARDIAC AND NEUROLOGICAL EQUIPMENT   9
CARDIAC EQUIPMENT -Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Arrhythmia Simulator, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting.
NEUROLOGICAL EQUIPMENT- Clinical significance of EEG, Multi channel EEG recording system, Epilepsy, Evoked Potential –Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG system maintenance and troubleshooting.

UNIT II   ULTRASONIC TECHNIQUE   9
Basic principles of Echo technique, display techniques A, B and M mode, Applications of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology. Doppler effect and its application.

UNIT III   RESPIRATORY MEASUREMENT SYSTEM   9
Instrumentation for measuring the mechanics of breathing – Spirometer-Lung Volume and vital capacity, measurements of residual volume, pneumotachometer - Airway resistance measurement, Whole body plethysmography, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor, Oximetry- Invitro oximetry, Invivo oximetry, Ear oximeter,Pulse oximeter

UNIT IV   SENSORY MEASUREMENT   9
Psycho Physiological Measurements-for testing and sensory responses, Electroocculograph, Electroretinograph, Audiometer-Puretone, Speech. EGG(Electro gastrograph), basal skin resistance (BSR), galvanic skin resistance (GSR).

UNIT V   PATIENT MONITORING AND BIOTELEMETRY   9
Patient monitoring systems, ICU/CCU equipments, bed side monitors, Infusion pumps, Central consoling controls. Radio Telemetry (Single and multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.
                                              TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Understand the basics of Cardiac and neurological equipment
CO2: Gain knowledge on EEG signal and EEG machine.
CO3: Understand the mechanism of measurements in respiratory
CO4: Understand about the different sensory measurement techniques
CO5: Learn the working of ICU/CCU equipment and applications in ECG and EEG Transmission.

TEXT BOOKS:
1.Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology",

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Fourth edition, Pearson education, 2003.
2. John G. Webster , Amit J. Nimunkar, Medical Instrumentation: Application and Design, Fifth Edition, Wiley India Edition, 2020.

REFERENCE BOOKS:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", Second Edition , McGraw Hill,2009.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Third edition, Tata McGraw Hill, 2014.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation". Third edition, Wiley India Edition ,2008
4. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Second Edition, *Pearson* Education, 2016.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the basics of Cardiac and neurological equipment	3		2		3	1						3	2	1	
CO2	Gain knowledge on EEG signal and EEG machine	3		2		3	2						3	2	1	
CO3	Understand the mechanism of measurements in respiratory	3		2		3	2						3	2	1	
CO4	Understand about the different sensory measurement techniques	2		2		3	2						3	2	1	
CO5	Learn the working of ICU/CCU equipment and applications in ECG and EEG Transmission	2		2		3	2						3	2	1	

618BMT02	THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To understand the principle of diathermy equipment and its types.
- To learn various cardiac therapeutic equipments
- To study the functioning of muscle and nerve stimulators.
- To acquire the knowledge of various extra-corporeal devices
- To gain knowledge on patient's electrical environment and also on electrical safety codes and standards implemented towards the concern

UNIT I   DIATHERMY EQUIPMENT   9

Principles of surgical diathermy – Surgical diathermy machine- Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.High frequency therapy - Short wave diathermy, Ultrasonic diathermy, Microwave diathermy, Principles of Cryogenic technique and application.

UNIT II   CARDIAC PACEMAKER AND DEFIBRILLATOR   9

Cardiac Pacemaker- Internal, External Pacemaker and Programmable pacemaker –Batteries, electrodes and leads system, pacing system analyzers, AC and DC Defibrillator- Types of Internal and External Defibrillator, defibrillator safety and analyzers, RF ablation treatment for arrhythmia, Atherectomy.

UNIT III   PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS   9

Principles of physical therapy, Therapeutic heat, Pain relief through electrical stimulation –Tissue Responses to electrical stimulation, Muscle stimulator,TENS, spinal cord stimulator,brain stimulation for pain reduction, FES.IR and UV lamp and its applications.

UNIT IV   EXTRA CORPOREAL DEVICES   9

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, Haemodialyser unit, Lithotripsy, Endoscopy, Laparoscopy, Types of Ventilators – Pressure, Volume, Time controlled flow, Patient Cycle Ventilators, neonatal ventilators, ventilator testing, Humidifiers, Nebulizers, Inhalators

UNIT V   PATIENT SAFETY   9

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards– Patient's electrical environment – Isolated Power system – Conductive surfaces –Medical safety codes and regulatory standards- IEC 60601-1 2005 standard, Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of this course, students will be able to:
CO1: Learn the types and uses of diathermy technique and application.
CO2: Understand the defibrillator and pacemaker devices
CO3: Study the working of physiotherapy and electrotherapy equipment
CO4: Understand the working of extra-corporeal devices like Heart-lung machine, oxygenator.
CO5: Gain the knowledge on patient's electrical environment and electrical safety codes

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TEXT BOOKS:

1. John G. Webster , Amit J. Nimunkar, "Medical Instrumentation: Application and Design", Fifth Edition, Wiley India Edition, 2020.
2. Joseph. Carr and John M. Brown, "Introduction to Biomedical equipment technology", John Willey and sons, 2003.

REFERENCE BOOKS:

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation",Third edition, Wiley India Edition ,2008.
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Second Edition, Pearson *Education, 2016.*
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Third edition, Tata McGraw Hill, 2014.
4. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", Second Edition , McGraw Hill,2009.

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Learn the types and usesof diathermy technique and application.	3		2		3	1						3	2	1	
CO2	Understand the defibrillator and pacemaker devices	3		2		3	2						3	2	1	
CO3	Study the working of physiotherapy and electrotherapy equipment	3		2		3	2						3	2	1	
CO4	Understand the working of extra-corporeal devices like Heart-lung machine, oxygenator	2		2		3	2						3	2	1	
CO5	Gain the knowledge on patient's electrical environment and electrical safety codes	2		2		3	2						3	2	1	

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:
- To get the clear understanding of X-ray generation and its application
- To study the functioning of computed tomography
- To understand the conceptof magnetic resonance imaging.
- To gain knowledge on the radio isotopes and radiation detectors
- To study the special techniques adopted in radiation therapy

UNIT I   MEDICAL X-RAY EQUIPMENT   9

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, Causes of x-ray tube failure: Electron arcing/filament burn out, Failure to warm up tube, High temp due to over exposure, x-ray tube rating charts. Image characteristics, X-Ray Image intensifier tubes - Fluoroscopy – Digital Fluoroscopy. Angiography, Cine angiography. Digital Subtraction Angiography, Mammography, Dental X-ray machines

UNIT II   COMPUTED TOMOGRAPHY   9

Principles of Tomography – Evolution of CT, X-Ray Sources – Collimation – X-Ray Detectors – Image reconstruction technique- Back projection and Iterative method, Viewing System, Patient dose in CT. Spiral CT Scanning - Ultra fast CT Scanners, 3D Imaging and its application.

UNIT III   MAGNETIC RESONANCE IMAGING   9

Fundamentals of Magnetic Resonance- Interaction of nuclei with static Magnetic Field and Radio frequency wave – Rotation and Precession –induction of a magnetic resonance signal – bulk Magnetization – Relaxation Processes T1 and T2. Block diagram approach of MRI system- System Magnet (Permanent, Electromagnet and super conductors), generation of Gradient magnetic Fields, Radio Frequency coils (sending and receiving) Shim coils, Electronic components, fMRI.

UNIT IV   NUCLEAR MEDICINE SYSTEMS   9

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, Radionuclide imaging- Bone imaging, myocardial perfusion

UNIT V   RADIATION THERAPY AND SAFETY EQUIPMENT   9

Radiation therapy-Linear accelerator, betatron, cesium and cobalt. 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, ICRP regulation Practical reduction of dose to staff and visitors.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Learn X ray equipments, their imaging techniques, appreciate their usage in the radiology department of hospital

CO2: Gain an adequate knowledge about the fundamentals of CT imaging techniques

CO3: Know about the MRI imaging and their usage

CO4: Gain adequate knowledge about Nuclear medicine system

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CO5: Understand about radiation therapy and its safety

TEXT BOOKS:
1. M A Flower, Webb's Physics of Medical Imaging , Second Edition, CRC Press, 2012.
2. William R. Hendee and Russell Ritenour, Medical Imaging Physics, Wiley, Fourth Edition 2002.

REFERENCE BOOKS:
1. Gopal B.Saha ,Physics and Radiobiology of Nuclear Medicine, Third edition, Springer publication, 2006.
2. B.H Brown , PV Lawford, R H Small wood , D R Hose , D C Barber , Medical Physics and Biomedical Engineering, First edition, CRC Press, 1999.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", Second Edition ,McGraw Hill,2009.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Learn X ray equipments, their imaging techniques, appreciate their usage in the radiology department of hospital	3	2	2	2	3	1				2	2	3	2	1	
CO2	Gain an adequate knowledge about the fundamentals of CT imaging techniques	3	2	2	2	3	2				2	2	3	2	1	
CO3	Know about the MRI imaging and their usage	3	2	2		3	2				2	2	3	2	1	
CO4	Gain adequate knowledge about Nuclear medicine system	2	3		2	3	2				2	2	3	2	1	
CO5	Understand about radiation therapy and its safety	2	3	2		2	2				2	2	3	2	1	

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BIOMATERIALS AND ARTIFICIAL ORGANS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the basics of biomaterials and compatibility.
- To study the characteristics and medical applications of metallic implants
- To understand the characteristics of polymeric implants materials.
- To understand the different soft and hard tissue replacements
- To study the artificial organs.

UNIT I   STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY   9

Definition and classification of bio-materials, mechanical properties, viscoelasticity, wound-healing process, body response to implants, blood compatibility.

UNIT II   IMPLANT MATERIALS   9

Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics carbons, Nano materials, medical applications.

UNIT III   POLYMERIC IMPLANT MATERIALS   9

Polymerization, polyamides, Acrylic polymers, rubbers, high strength thermoplastics, medical applications. Bio polymers: Collagen and Elastin.

UNIT IV   TISSUE REPLACEMENT IMPLANTS   9

Soft-tissue replacements, sutures, surgical tapes, adhesives, Percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

UNIT V   ARTIFICIAL ORGANS   9

Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyzer membrane), Dental Implants, 3D organ printing.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Gain Knowledge about the characteristics of biomaterials.
CO2: Study the applications of metallic implants.
CO3: Learn the properties, characteristics and applications of polymeric implants
CO4: Learn about skin implants and blood interfacing implants
CO5: Gain knowledge on the artificial organs.

TEXT BOOKS

1. Sujata V. Bhatt, "Biomaterials", Narosa Publishing House, Seventh Edition, 2005.
2. Joon B.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press, 2003.

REFERENCE BOOKS

1. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.

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2. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", Second Edition, McGraw Hill, 2009.
3. John Enderle, Joseph D. Bronzino, Susan M "Introduction to Biomedical Engineering", Blanchard, Elsevier, 2005.

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Gain Knowledge about the characteristics of biomaterials	3	2	2			1						2	3	1	
CO2	Study the applications of metallic implants	3	2	2			1						2	3	1	
CO3	Learn the properties, characteristics and applications of polymeric implants	3	2	2			1						2	3	1	
CO4	Learn about skin implants and blood interfacing implants	3	1	2			1						2	3	1	
CO5	Gain knowledge on the artificial organs	3	1	2			1						2	3	1	

618BME05	MEDICAL SAFETY AND QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To understand how safety is important for health care systems.
- To gain knowledge about shocks and leakage current.
- To understand the safety in medical imaging and ventilation
- To know about safety codes, standards and regulations.
- To learn responsibility to maintain quality management, risk management.

UNIT I   SAFETY IN HEALTH CARE   9

Quality assurance, Safe medical devices – device requirements - devices for varying age – initial inspection – maintenance. Safe handling and operation, Reporting, Bed rails, Flawed mechanics, removable parts and packaging.

UNIT II   ELECTRICITY, GAS, FIRE SAFETY IN HOSPITALS   9

Macroshock and Microshock, Current, Voltage and conductance, Earth and protection classes, earth fault circuit breakers and isolation transformers, leakage currents in medical equipment, biological effects of electromagnetic fields, Susceptibility to water. Gas technology and Fire in hospital, Thermal injuries, Case study

UNIT III   SAFETY IN MEDICAL IMAGING AND VENTILATION   9

Quality assurance and image improvement in diagnostic radiology with X-rays, specific quality assurance tests for X-rays. MRI safety. Risks in Ventilators, anesthetic machines, oxygen treatment, treatment with Nitric oxide, pressure chamber treatment, Incubators and monitoring, Case Study-DICOM image

UNIT IV   SAFETY CODES, STANDARDS AND REGULATIONS   9

Electrical safety codes and standards-Medical Devices, Standards- Need for Standards , Voluntary and mandatory standards , Standards development process , Conformity assessment, ISO,EEC, IEC, CE, FDA,IMDR, CEN, CENELEC, IEC 60601-1, IEC 60601-1-2, IEC 60601-1-3, Case study- Bio waste management

UNIT V   RISK MANAGEMENT AND SAFETY HAZARDS   9

Quality management, risk management, types of responsibilities, delegating, procurement, status and other publications, overall responsibility, safety aspects, Implantable devices, safety hazards.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Understand how safety is important for health care systems.
CO2: Gain knowledge about shocks and leakage current.
CO3: Know about the need for standards and codes.
CO4: Learn about safety codes, standards and regulations.
CO5: Learn the responsibility to maintain quality management, risk management.

TEXT BOOKS:
1. Bertil Jacobson and Alan Murray, "Medical Devices use and safety", Reed Elsevier India Pvt. Ltd, New Delhi, 2011.
2. Michael Cheng, "Medical device regulations: global overview and guiding principles", World Health Organization 2003.

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REFERENCE BOOKS:
1. M A Flower, Webb's Physics of Medical Imaging, Second Edition, CRC Press, 2012.
2. G.D.Kunders, "Hospitals Facilities Planning & Management", Tata Mcgraw Hill, 2013.
3. Joseph. Carr and John M. Brown, "Introduction to Biomedical equipment technology", John Willey and sons, 2003.

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand how safety is important for health care systems	1					2	1	2				1	2	3	
CO2	Gain knowledge about shocks and leakage current	1					2	1	2				1	2	3	
CO3	Know about the need for standards and codes	1					1	1	2				1	2	3	
CO4	Learn about safety codes, standards and regulations	1					3	1	1				1	2	3	
CO5	Learn the responsibility to maintain quality management, risk management	1					3	1	2				1	2	3	

COURSE OBJECTIVES:
- Grasp the principles of data communication and to learn various mediums used in Physical layer
- Understand the functions of Data link layers.
- Understand the networking concepts and different routing protocol
- Get familiarized with different Transport and application layer protocols.

UNIT I   DATA COMMUNICATIONS & PHYSICAL LAYER   8

Introduction: Components –Data representation –Direction of Data flow – Networks: criteria and physical structure – Network Types –Protocols and Standards – Layered Tasks–ISO / OSI model and layers in the OSI model – Addressing. Performance Metrics - Transmission Media: Guided Transmission Media –Twisted pair – Coaxial Cable – Fiber Optics – Unguided Media – Radio waves – Microwaves–Infrared. Network Components: Connectors – Transceivers – Media converters – Network Interface card – PC cards.

UNIT II   DATA LINK LAYER   10

Error Detection and Correction: Types of Errors–Redundancy– LRC – CRC –Checksum- Data Link Control: Flow and Error control Protocols: Stop and wait – Stop and wait ARQ - Go back-N ARQ – Selective repeat ARQ- Sliding window – HDLC. Media Access Control (MAC) – CSMA / CD - Wired LAN: Ethernet IEEE 802.3 –IEEE 802.4 – IEEE 802.5 – Virtual LAN.

UNIT III   NETWORK LAYER   10

Logical Addressing: IPv4 Addresses – Ipv6 Addresses - Connecting Devices: Repeaters – Hubs– Bridges – Switches – Routers – Modems – Gateways - Switching: Circuit Switching - Packet Switching– Logical Addressing: IPv4 Addresses – Ipv6 Addresses - Internet Protocols: IPV4 – IPV6 - Unicast Routing Protocols: Distance Vector Routing – Link State Routing –Address Mapping: ARP, RARP- ICMP.

UNIT IV   TRANSPORT LAYER   9

Process to process delivery –User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control Techniques– Congestion Prevention Policies - Quality of services (QoS) – Techniques to improve QoS - Integrated Services - Differentiated Services.

UNIT V   APPLICATION LAYER   8

Domain Name Space (DNS) – SMTP – POP3 – WWW - FTP – HTTP – SNMP – SSO

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of data communication and networking
CO2: Explore various flow and error control protocols in data link layer.

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CO3: Understand and evaluate the performance of various routing algorithms.

CO4: Analyze flow control and congestion control algorithm for QoS at end to end level.

CO5: Explore the features and operations of various application layer protocols.

TEXT BOOK:

1. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw-Hill Publishing Co. Pvt., Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition PHI Learning, New Delhi, 2016.
2. William Stallings, "Data and Computer Communication", Tenth Edition, Pearson Education, New Delhi 2014.
3. Alberto Leon Garcia and Indra Widjaja, "Communication Networks Fundamental Concepts and key Architectures", Second Edition, Tata McGraw-Hill Publishing Co. Pvt., Ltd., New Delhi, 2009.
4. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, New Delhi 2012.
5. Larry L.Peterson and Peter S. Davie, "Computer Networks", Fifth Edition Harcourt Asia Pvt. Ltd.,USA, 2011.
6. Prakash C Gupta, "Data Communications and Computer Networks", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2009.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the fundamentals of data communication and networking	2		1		1					2					1
CO2	Explore various flow and error control protocols in data link layer	2		1			1				1					1
CO3	Understand and evaluate the performance of various routing algorithms	2		1		1	1									1
CO4	Analyze flow control and congestion control algorithm for QoS at end to end level.	2		1							2					1
CO5	Explore the features and operations of various application layer protocols	2		1		1				2		2				1

COURSE OBJECTIVES:
- To study various display techniques and use of ultrasonic's in various fields of medicine
- To understand various patient monitoring systems and transmission of biosignals using telemetry principles
- To study the clinical applications of diathermy, its principle and types.
- To study some of extra-corporeal devices and few of the diagnostic techniques.
- To study the sources of leakage current and method of monitoring it.

LIST OF EXPERIMENTS:
1) Analysis of ultrasonic transducers and displays.
2) Analysis of pacemaker.
3) Analysis of shortwave diathermy.
4) Analysis of ultrasonic diathermy unit.
5) Simulation of biosignals.
6) Analysis of ECG signals.
7) Analysis of EEG signals.
8) Multichannel data acquisition system
9) Recording of single channel biotelemetry system.
10) Study of Leakage current and electrical safety measurements.

TOTAL HOURS: 60 PERIODS

COURSE OUTCOMES
Upon Completion of this course, students will be able to:
CO1: Understand the basic and principle of ultrasound.
CO2: Know about telemetry and the various bio-telemetric units
CO3: Identify the types and uses of diathermy units.
CO4: Know the tissue responses and about electro-surgical units

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the basic and principle of ultrasound	3		2		3	2			2			3	3	2	
CO2	Know about telemetry and the various bio-telemetric units	3		2		3	2			2			3	3	2	
CO3	Identify the types and uses of diathermy units	3		2		3	2			2			3	3	2	
CO4	Know the tissue responses and about electro-surgical units	3		2		3	2			2			3	3	2	

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COURSE OBJECTIVE:

- To enhance the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations

LIST OF EXPERIMENTS:

1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using appropriate body language in professional contexts – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics – brainstorming the topic
7. Training in soft skills - persuasive skills – People skills - questioning and clarifying skills – mock GD
8. Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL HOURS: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Enhancing the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills

CO2: Improving their soft skills, including report writing, necessary for the workplace situations

CO3: Creating effective PPTs and presenting the visuals effectively

CO4: Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report

REQUIREMENTS FOR A CLASS OF 30 STUDENTS

1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD's and DVD's on relevant topics

REFERENCE BOOKS:

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.

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3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READERS:

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES:

1. www.humanresources.about.com
2. www.careerride.com
3. http://nptel.ac.in/courses/109104031/
4. http://nptel.ac.in/courses/109106067/

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Enhancing the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills					1	2			2	3	3				
CO2	Improving their soft skills, including report writing, necessary for the workplace situations					1	2			3	3				3	3
CO3	Creating effective PPTs and presenting the visuals effectively														3	3
CO4	Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report									3	3	2		3		

                                                                                       0   0   2   1

COURSE OBJECTIVES:

- Observe medical professionals at work in the wards and the roles of Allied Health Professionals.
- Provide access to healthcare Professionals to get a better understanding of their work.
- Demonstrate patient-care in a hospital setting.

ASSESSMENT:

- Students need to complete training in any leading Multi-specialty hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in- charges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

S.No.	Departments for visit
1	Cardiology
2	ENT
3	Ophthalmology
4	Orthopaedic and Physiotherapy
5	ICU/CCU
6	Operation Theatre
7	Neurology
8	Nephrology
9	Radiology
10	Nuclear Medicine
11	Pulmonology
12	Urology
13	Obstetrics and Gynaecology
14	Emergency Medicine
15	Biomedical Engineering Department
16	Histo Pathology
17	Biochemistry
18	Paediatric/Neonatal
19	Dental
20	Oncology
21	PAC's
22	Medical Records / Telemetry

TOTAL HOURS: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Advocate a patient-centred approach in healthcare

CO2: Communicate with other health professionals in a respectful and responsible manner

CO3: Recognize the importance of inter-professional collaboration in healthcare.

CO4: Propose a patient-centred inter-professional health improvement plan based upon the

patient's perceived needs

CO5: Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Advocate a patient-centred approach in healthcare	3			2		3		2	2	2	1	2	2	3	1
CO2	Communicate with other health professionals in a respectful and responsible manner		2		2		3		2	2	2	1	2	2	3	1
CO3	Recognize the importance of inter-professional collaboration in healthcare		2		2		3		2	2	2		2	2	3	1
CO4	Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs		2		2		3		2	2	2		2	2	3	1
CO5	Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served		2		2		3		2	2	2		2	2	3	1

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COURSE OBJECTIVES:

- To analyze the optical properties of tissue and its light applications in the field of medicine.
- To summarize the instrumental components in photonics.
- To discuss the different applications of lasers used in medicine.
- To understand the principles of optical coherence tomography.
- To summarize the different advanced optical techniques.

UNIT I   OPTICAL PROPERTIES OF THE TISSUES   9

Fundamentals of optical properties-Refraction, Scattering, Absorption, Light transport inside the tissue-Coherence and incoherent light, Radiation transport equation, Tissue properties, Light interaction with tissues-Optothermal interaction, Fluorescence, Formation of speckles.

UNIT II   INSTRUMENTATION IN PHOTONICS   9

Basic Spectrometer-Basic apparatus, Instrument for absorption, scattering and emission measurements, Instrumental components-Excitation light sources – High pressure arc lamp, Solid state LEDs, Lasers, Optical fibers and dispersive devices-Optical filters, Polarizer, Single channel and multichannel detectors, Detection Methods-Time resolved and Phase resolved detection methods.

UNIT III   APPLICATIONS OF LASERS   9

Medical Laser system-fundamentals, principles. Laser safety-fundamentals. Laser interaction with tissue-principles; laser assisted diagnostic –principles, application of lasers in diagnosis and imaging-advances, laser surgery and therapy –principles-photothermal & photomechanical mechanism, thermal interaction between laser and tissue-advances, Holmium Laser.

UNIT IV   OPTICAL COHERENCE TOMOGRAPHY   9

Optical coherence tomography (OCT)-Principles of operation, Optical coherence tomography technology and systems, OCT Elastography, Principles of Doppler OCT, Application towards clinical imaging.

UNIT V   ADVANCED OPTICAL TECHNIQUES   9

Near field optical microscopy, Fluorescence Resonance Energy Transfer (FET) imaging, Fluorescence Lifetime Imaging Microscopy(FLIM), Photodynamic therapy (PDT)-Basic principles, Mechanism of photodynamic action, Light irradiation for PDT, Application of PDT.

                                        TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Identify the light interaction with the tissues.
CO2: Analyze the optical fibers and dispersive devices.
CO3: Formulate the laser surgery and therapy.

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CO4: Summarize the applications of OCT in clinical imaging.
CO5: Understand the principles and applications of photodynamic therapy.

TEXT BOOKS:
1. Tuan Vo Dinh, "Biomedical photonics – Handbook", CRC Press, 2019 (Unit I,II,IV,V)
2. Abraham Katzir "Laser and optical fibers in Medicine", Academics Press,2012 (Unit-III)

REFERENCE BOOKS:
1. Mark E. Brezinski., Optical Coherence Tomography: Principles and Applications,Academic Press, 2006 (Unit-IV)
2. Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and Sons, Inc. Publications, 2003 (Unit-V)
3. Anders Brahme ,"Comprehensive biomedical physics",Elsevier,2014
4. Leon Goldman, M.D., & R. James Rockwell, Jr., "Lasers in Medicine", Gordon and Breach, Science Publishers Inc., New York, 1971.
5. R. Splinter and B.A Hooper, "An Introduction to Biomedical Optics", Taylor and Francis,2007

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Identify the light interaction with the tissues	3			2	3			3				2	3	1	3
CO2	Analyze the optical fibers and dispersive devices	3		2									2	3	1	
CO3	Formulate the laser surgery and therapy	3		2				2					2	3	1	
CO4	Summarize the applications of OCT in clinical imaging	3		2				2					2	3	1	
CO5	Understand the principles and applications of photodynamic therapy	3		2	2			2	3		3	3	2	3	1	

718BMT02	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate digital image fundamentals.
- To explain the concepts in image enhancement.
- To interpret the methods in image segmentation.
- To classify the image restoration techniques.
- To estimate digital images using compression techniques.

UNIT I   DIGITAL IMAGE FUNDAMENTAL AND TRANSFORMS   9

Elements of digital image processing systems, Digital Camera working principles, - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II   IMAGE ENHANCEMENT   9

Gray level transformation – Histogram processing – enhancement using arithmetic/logic operation – spatial filtering – smoothening and sharpening spatial filter – smoothening in frequency domain filter – homomorphic filtering, color image enhancement.

UNIT III   IMAGE SEGMENTATION   9

Introduction– detection of discontinuities – edge linking and boundary detection – thresholding – region based segmentation – segmentation by morphological watersheds – use of motion in segmentation.

UNIT IV   IMAGE RESTORATION   9

Image degradation models – unconstrained and constrained restoration – inverse filtering – Weiner filtering - LMS filter – geometric mean filter – geometric transformation – Medical applications in image processing- image registration.

UNIT V   IMAGE COMPRESSION   9

Image compression models – elements of information theory – error free compression –lossy compression – run-length – shift codes – arithmetic coding – bit plane coding – transform coding – JPEG standards – MPEG standards –DICOM standards, wavelet transform – predictive techniques – block truncation coding schemes, Case studies.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Summarize the digital image fundamentals and classify the transform techniques.
CO2: Apply the concept in image enhancement techniques for digital images.
CO3: Dissect the images using segmentation technique.
CO4: Determine the restoration technique for digital images and examine its recognition.
CO5: Evaluate the digital images using compression techniques

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TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing" Pearson Education, 4th edition 2018.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI, 2007

REFERENCE BOOKS:

1. Kenneth R. Castleman, "Digital Image Processing", PHI, 2010.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", PHI, 2017.
3. S.Sridhar, " Digital Image processing" Oxford University press, Edition 2013
4. Bhabatosh Chanda, "Digital Image Processing And Analysis" Prentice Hall India Learning Private Limited, 2011

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Summarize the digital image fundamentals and classify the transform techniques	3	2		3		2					3		3	1	
CO2	Apply the concept in image enhancement techniques for digital images	3	2		3		2			3		3		3	1	
CO3	Dissect the images using segmentation technique.	2		2		3		2	2	2		1	2	3	2	2
CO4	Determine the restoration technique for digital images and examine its recognition	2		2		3		2	2	2		1	2	3	2	2
CO5	Evaluate the digital images using compression techniques	3	2		3	3				3		3		3	1	

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BIOMECHANICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
- To apply the principles of mechanics that is used to analyse human movement.
- To demonstrate about the fluid mechanic system applied to human body
- To classify the structure and functions of skeletal muscle
- To explain the structure, movements, and loads applied to knee, shoulder and hip.
- To categorize the bone structure joints and cartilage

UNIT I   INTRODUCTION TO MECHANICS   9

Newton's law- mechanical behaviour of bodies in contact, work, power and energy relationship – Stress strain analysis, Angular kinematics of human movement-measuring angles, angular kinematic relationships –relationships between linear and angular motion – Angular kinetics of human movement-resistance to angular acceleration, angular momentum

UNIT II   BIOFLUID MECHANICS   9

Newtonian viscous fluid – Non viscous fluid – Viscoelasticity – - Viscosity – Fluid motion-Fluid structure interaction-Heart valve function-Blood Rheology-Pressure, flow and resistance in arterial and venous system

UNIT III   MECHANICS OF SKELETAL MUSCLE   9

The Functional Arrangement of Muscles -Structure of skeletal muscle –muscle fibers, motor units – Sliding element theory of muscle action.- Single Twitch and Wave Summation -Contraction of skeletal muscle bundles and Hill's three element model

UNIT IV   MECHANICS OF SHOULDER, KNEE AND HIP   9

Structure of the shoulder – Movements of shoulder complex – Loads on the shoulder –Structure of the Knee – Movements of the Knee –Loads on the Knee – Structure and movements of the hip – Loads on the hip, Gait Analysis-abnormal gait-corrective measures.

UNIT V   ORTHOPAEDIC MECHANICS   9

Mechanical properties of bone, Structure and functions of bone, Mechanical properties of cartilage – – Viscoelastic properties of articular cartilage – The Lubrication Quality of Articular Cartilage Surfaces, Joint Architecture – Joint Stability- Joint Flexibility, Ortho implants-types and applications.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Define the relationship between various motions by the principles of mechanics.
CO2: Explain about the fluid motion and interaction inside the human body
CO3: Outline the Functional Arrangement of Muscles
CO4: Summarize the movements and the loads on knee, shoulder and hip.
CO5: Analyze the mechanical properties of bone, joints and cartilage

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TEXT BOOKS:

1. Fung, Y.C., "Biomechanics: Mechanical Properties of Living Tissues", Springer, 3rd edition, 1993 (Unit-II,III,V)
2. Susan .J. Hall: "Basic Biomechanics", Tata McGraw hill, 4th edition, 2004 (Unit-I,IV,V)

REFERENCE BOOKS:

1. Dawson, D. and Right, "Introduction to Biomechanics of Joints and Joint Replacement", Mechanical Engineering Publication Ltd, 2010.
2. Jacob Cline, "Handbook of Biomedical Engineering", Academic Press Inc., 1988.
3. David A.Rubenstein,Wei Yin and Mary D.Frame,"Biofluid Mechanics:An introduction to Fluid mechanics, Macrocirculation and Microcirculation", Academic Press Inc.,2nd edition,2015 (Unit-II)
4. Jim Richards, The Comprehensive Textbook of Clinical Biomechanics Elsevier; 2nd edition (1 June 2018)
5. Ronald L. Huston ," Fundamentals of Biomechanics", CRC Press; 1st edition 2013

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Define the relationship between various motions by the principles of mechanics	3	2	3	3	2	3						2	3	1	
CO2	Explain about the fluid motion and interaction inside the human body	3	2	3	3	2	3						2	3	1	
CO3	Outline the Functional Arrangement of Muscles	3	2	3	3	2	3						2	3	1	
CO4	Summarize the movements and the loads on knee, shoulder and hip	3	2	3	3	2	3						2	3	1	
CO5	Analyze the mechanical properties of bone, joints and cartilage	3	2	3	3	2	3						2	3	1	

718BMT04	MEDICAL INFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To analyze the role of informatics in engineering and medicine.
- To understand the importance of medicine and the internet.
- To summarize the concept in medical imaging and clinical laboratory.
- To identify the importance of tele medicine and hand held computers.
- To understand the importance of computer aids for the physically challenged.

UNIT I   MEDICAL INFORMATICS BASICS   9

Introduction – Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and Off– line services - History taking by computer, Dialogue with the computer

UNIT II   MEDICINE AND THE INTERNET   9

Internet-Internet Services, uses of internet in Medicine, Internet vs Online services. Security issues in computer and internet-Confidentially through cryptography, Digital Signature, User Authentication, Standards- HL7, JCAHO, JCIA

**UNIT III   COMPUTER ASSISTED MEDICAL IMAGING AND CLINICAL
                   LABORATORY   9**

Computers in Nuclear Medicine, Radiation Therapy planning. Computers in a clinical laboratory-Automated Clinical Laboratories, Automated Methods in hematology, Chromosome analysis by Computer, Intelligent laboratory Information System (ILIS), Computer Assisted Semen Analysis (CASA)

UNIT IV   TELEMEDICINE AND TECHNOLOGY   9

Telemedicine and internet, Medical Peripheral devices, Applications of telemedicine, Satellite Based Telemedicine. Hand-Held Computers-Palm Top Personal Digital Assistant (PDA), Picture Achieving and Communication System (PACs), Electronic health record (EHR).

UNIT V   COMPUTER ASSISTIVE DEVICES FOR THE PHYSICALLY CHALLENGED   9

Mobility-EMG controlled Limbs, Blind and visually physically challenged, Concept of Artificial Retina, Computer Aids for the Deaf, Computer speech Generation and recognition, Robotics to assist the elderly infirm, Smart medical homes, Personalized e-Health Services.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of this course, students will be able to:
CO1: Analyze the health informatics and bioinformatics.
CO2: Summarize the importance of Medical standards
CO3: Identify the concept in radiation therapy planning
CO4: Elaborate the applications of telemedicine
CO5: Understand the importance of smart medical homes

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TEXT BOOKS:

1. R.D.Lele, "Computers in medicine progress in medical informatics", Tata Mcgraw Hill Publishing computers Ltd,2005, New Delhi.
2. Mohan Bansal, "Medical informatics", Tata Mcgraw Hill Publishing computers Ltd, 2003 New Delhi

REFERENCE BOOKS:

1. N.Mathivanan, "PC-Based Instrumentation", Prentice Hall of India Pvt Ltd – New Delhi – 2007.
2. Orpita Bosu and Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press, 2007, New Delhi.
3. Yi – Ping Phoebe Chen, "Bioinformatics Technolgies", Springer International Edition, 2007, New Delhi
4. Bhatia Dinesh, "Medical Informatics", PHI Learning Private Limited ,2015
5. Dr. K C Mishra ," Medical Informatics: An Exploration", DGM Icfai Books 2008

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Analyze the health informatics and bioinformatics	3		2			2		2		2	2		2	1	
CO2	Summarize the importance of Medical standards	3		2			2		2		2	2		2	1	
CO3	Identify the concept in radiation therapy planning	3		2			2		2		3	3		2	1	
CO4	Elaborate the applications of telemedicine	3		2			2		2		3	3		2	1	
CO5	Understand the importance of smart medical homes	3		2			2		2		3	3		2	1	

COURSE OBJECTIVES:
- To apply the concept of Rehabilitation & Rehabilitation team members
- To find knowledge about Orthotic devices in Rehabilitation Engineering
- To extend the knowledge about Therapeutic exercise technique.
- To analyze the Principles in Management of communication and virtual reality.
- To explain the general principles of Amputation surgery

UNIT I   INTRODUCTION TO REHABILITATION & REHABILITATION TEAM   9

Introduction to Rehabilitation, Medical rehabilitation, Preventive Rehabilitation-Levels of prevention, Impairment, disability & handicap-Diagnosis of disability, Functional diagnosis, Primary & secondary Disabilities, Rehabilitation team- medical and paramedical team members, socio-vocational team members.

UNIT II   ORTHOTIC DEVICES IN REHABILITATION ENGINEERING   9

General principles of Orthosis- Biomechanics of orthosis, Classification of orthotics-Functional & Regional ,merits & demerits of orthotics, Material and fabrication for lower limb orthosis , Calipers- FO, AFO, KAFO, HKAFO. Spinal Orthosis-Types of spinal orthosis-Cervical, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbosacral orthosis, Splints- functions & types.

UNIT III   THERAPEUTIC EXERCISE TECHNIQUE   9

Coordination exercises-Components of coordinated activity, General principles of coordination tranining, Frenkel's exercises, Gait–Gait analysis, 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 AND VIRTUAL REALITY   9

Introduction to communication, Speech, Aphasia, Types of aphasia, Dysarthria, Speech therapy, Augmentative communication-general form of communication, types of visual aids, 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   AMPUTATION AND PROSTHETIC DEVICES   9

General principles of Amputation surgery, Upper limb amputation, Levels of upper limb Amputation, Lower limb amputation, Rehabilitation of lower limb amputation, Prosthetics- Classification, Components of prosthesis, Upper limb prosthetics, above elbow prosthesis, below elbow prosthesis, Prosthesis for lower extremity

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Apply the levels of prevention in rehabilitation.
CO2: Develop the orthotic devices for the differently abled.
CO3: Explain about the importance Therapeutic exercise techniques and the training methods.

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CO4: Demonstrate the virtual reality based rehabilitation aids.
CO5: Estimate the amputation level & choosing appropriate Prosthetic devices.

TEXT BOOKS:
1. Dr. S. Sunder, "Text book of Rehabilitation", 3rd Edition, Jaypee Medical Publications, 2010

REFERENCE BOOKS:
1. Joseph D.Bronzino, "The Biomedical Engineering Handbook", Third Edition: Three Volume Set, CRC Press, 2006
2. Rory A Cooper, "An Introduction to Rehabilitation Engineering", Taylor & Francis, CRC press, 2006.
3. Susan B O'Sullivan, Thomas J Schmitz, "Physical Rehabilitation", 5th Edition, Davis publications, 2007.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Apply the levels of prevention in rehabilitation	3		2			3	2					3	2	1	2
CO2	Develop the orthotic devices for the differently abled	3		2			3			2		2	3	2	1	2
CO3	Explain about the importance Therapeutic exercise techniques and the training methods	3	2	2			3		2	2		2	3	2	1	2
CO4	Demonstrate the virtual reality based rehabilitation aids.	3		2		2	3		2	2	2	2	3	2	1	2
CO5	Estimate the amputation level & choosing appropriate Prosthetic devices.	3			2		3		2	2		2	3	2	1	2

718BME14	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To generate an awareness on Human Values
- To explore the Senses of 'Engineering Ethics
- To instill Moral , Social Values and Loyalty
- To realize Safety ,Responsibilities appreciate the rights of Others
- To Analyze the various global issues

UNIT I   HUMAN VALUES   9

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality

UNIT II   ENGINEERING ETHICS   9

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 III   ENGINEERING AS SOCIAL EXPERIMENTATION   9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

UNIT IV   SAFETY, RESPONSIBILITIES AND RIGHTS   9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights -Intellectual Property Rights (IPR) - discrimination.

UNIT V   GLOBAL ISSUES   9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE),India, etc.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Generate an awareness on Human Values and Ethics
CO2: Analyze the theories in Senses of 'Engineering Ethics
CO3: Inculcate Moral , Social Values and Loyalty

CO4: Identify the Safety ,Responsibilities and Appreciate the rights of Others
CO5: Reflect on the various global issues and sample code of Ethics.

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York, 1996.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Professional Ethics and Human Values", Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOKS:

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education/ Prentice Hall, New Jersey, 2004 (Indian Reprint)
2. Charles E Harris, Michael S. Protchard and Michael JRabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, " Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists And Engineers", Oxford University Press, Oxford, 2001.
5. Dr. Naagarazan, RS ,"Professional Ethics and Human Values", New Age International (P) Ltd Publishers 2016

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Generate an awareness on Human Values and Ethics	1		1			2	2	3						3	
CO2	Analyze the theories in Senses of 'Engineering Ethics	1		1			2	2	3						3	
CO3	Inculcate Moral , Social Values and Loyalty	1		1			2	2	3						3	
CO4	Identify the Safety ,Responsibilities and Appreciate the rights of Others	1		1			2	2	3						3	
CO5	Reflect on the various global issues and sample code of Ethics	1		1			2	2	3						3	

		0	0	2	1

COURSE OBJECTIVES:

- To practice the basic image processing techniques.
- To understand the functions of transforms.
- To know the effect of quantization.
- To explore the applications of image processing

LIST OF EXPERIMENTS:

1. Histogram equalization
2. Linear and non linear filtering
3. Edge detection using operators
4. Two dimensional discrete Fourier transform
5. Discrete wavelet transform of images
6. Image Segmentation
7. Conversion between color spaces
8. Two dimensional discrete cosine transform
9. Filtering in frequency domain
10. Study of DICOM standards.
11. Stegnography
12. Medical Image Compression techniques.

COURSE OUTCOMES:

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

CO1: Perform filtering operations in the image
CO2: Use transforms and analyzes the characteristics of the image.
CO3: Analyze the texture of the image
CO4: Implement project on simple image processing applications.

TEXT BOOK:

1. Sreelal R K, Laboratory Manual For Digital Image Processing With Matlab & Python [Print Replica] Kindle Edition,2020

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Perform filtering operations in the image	3	3		2	3									3	2
CO2	Use transforms and analyzes the characteristics of the image	3	3		2	3									3	2
CO3	Analyze the texture of the image	2	2		2	3									3	2
CO4	Implement project on simple image processing applications	3	3	2	3	3									3	2

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78BMP08	MINI PROJECT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- It will cover all the aspects like investigation, designing, coding detailing, implementation of a biomedical Electronic circuits / systems in which the aspects like performance analysis, application of relevant standards etc., will find a place.
- Alternately, a few research problems also may be identified for investigation and the use of laboratory facilities to the fullest extent may be taken as a project work.

This laboratory would focus on training and honing technical skills of the students with regard to design and development of basic prototypes leading to low cost systems applied in the field of Biomedical Engineering. These prototypes will be used either to develop basic level rehabilitation tools and aids or to have decision making or control by the introduction of intelligence in the system. This laboratory is thus to provide a platform for the students to gain knowledge in the development of socially relevant projects in the field of Medical Electronics.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Culminate in gaining of major design experience in the related area of specialization.

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Culminate in gaining of major design experience in the related area of specialization	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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COURSE OBJECTIVES:

- To equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- To provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- To improve general and academic listening skills.
- To make effective presentations.

UNIT I   9

Listening as a key skill - its importance - speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification - Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II   9

Listening to process information - give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources - converse with reasonable accuracy over a wide range of everyday topics.

UNIT III   9

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist - listen for detail.

UNIT IV   9

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures - conversational speech - listening to and participating in conversations - persuade.

UNIT V   9

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL HOURS: 45 PERIODS

LAB REQUIREMENTS:

1. Teacher console and systems for students.
2. English Language Lab Software
3. Career Lab Software

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COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Listen and respond appropriately.
CO2: Participate in group discussions
CO3: Make effective presentations
CO4: Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:
1. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCE BOOKS:
1. Bhatnagar, Nitin and MamtaBhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.Vargo, Mari. Speak Now Level, Oxford University Press: Oxford, 2013.
3. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
4. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Listen and respond appropriately					1	2			2	3	3				
CO2	Participate in group discussions					1	2			3	3		3			3
CO3	Make effective presentations												3			3
CO4	Participate confidently and appropriately in conversations both formal and informal									3	3	2				3

818BMT01	HOSPITAL ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To understand the fundamentals of hospital administration and management
- To learn the concept of human resource management in hospital
- To know the market related research process
- To explore various information management systems and relative supportive services
- To learn the quality and safety aspects in hospital

UNIT I   OVERVIEW OF HOSPITAL ADMINISTRATION   9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning, Medical Ethics, Legal issues in hospital management, Current Issues in Hospital Management

UNIT II   HUMAN RESOURCE MANAGEMENT IN HOSPITAL   9

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   9

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   9

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. Telemedicine - Bio-Medical Waste Management.

UNIT V   QUALITY AND SAFETY ASPECTS IN HOSPITAL   9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABH,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, Calibration of medical equipments.

TOTAL HOURS: 45 PERIODS

COURSES OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Understand the concepts of hospital administration and biomedical waste management
CO2: Apply the ideas of man power management in hospitals
CO3: Analyze the marketing information system
CO4: Explore various clinical and management information systems
CO5: Know the medical standards and safety aspects in hospitals

TEXT BOOKS:

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI Learning, Seventh edition, 2017.
2. G.D.Kunders, "Hospitals -Facilities Planning and Management" TMH, New Delhi, Tenth Reprint, 2008.

REFERENCE BOOKS:

1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, New York, First edition, 1977.
2. Norman Metzger, "Handbook of Health Care Human Resources Management", Aspen Publication Inc. Rockville, Second edition 1990.
3. William A. Reinke, "Health Planning For Effective Management" ,Oxford University Press.1988.
4. Blane, David, Brunner, "Health and social organization towards a health policy for the 21st Century", Eric Calrendon Press, First edition, 1996.
5. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", Cengage Learning, Sixth Edition, 2011.

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understand the concepts of hospital administration and biomedical waste management	1					3		2	2	2	1			2	3
CO2	Apply the ideas of man power management in hospitals	1					3		2	2	2	1			2	3
CO3	Analyze the marketing information system	1					2			2	2	1			2	3
CO4	Explore various clinical and management information systems						2		2	3	2	1			2	3
CO5	Know the medical standards and safety aspects in hospitals						2		3	2	1	1			2	3

818BME04	ASSIST DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To study various cardiac assist devices
- To learn the functioning of Hemodialysers
- To apply the principles of hearing aids
- To design various orthotic devices and prosthetic devices to overcome orthopedic problems.
- To demonstrate electrical stimulation techniques used in clinical applications.

UNIT I   CARDIAC ASSIST DEVICES   9

Principle of External counter pulsation techniques,Intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, Pulmonary assist device.

UNIT II   HEMODIALYSERS   9

Artificial kidney, Dialysis action, Hemodialysis unit, Peritoneal dialysis, membrane dialysis, portable dialyser monitoring and functional parameters, Continuous Renal Replacement Therapy (CRRT), Urinary bladder replacement.

UNIT III   HEARING AIDS   9

Common tests – audiograms, air conduction, bones conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids, Cochlear implants.

UNIT IV   PROSTHETIC AND ORTHOTIC DEVICES   9

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, Transcutaneous Electrical Nerve Stimulator (TENS), Face Orthotics, Dental Implants, Bowel and hip replacement techniques.

UNIT V   BIOFEEDBACK   9

Bio-feedback - EMG, EEG, Electrodermal, Cardiorespiratory biofeedback, Applications of biofeedback, Brain Computer Interface

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to:
CO1: Apply various mechanical techniques that will help failing heart.
CO2: Analyze the functioning of the unit which does the clearance of urea from the blood
CO3: Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
CO4: Make use of the concepts of orthotic devices and prosthetic devices
        Illustrate the principles of TENS and Bio feedback

TEXT BOOKS:
1. Levine S.N., "Advances in Bio-medical Engineering and Medical physics", Vol. I, II, IV, inter university publications, New York, 1968
2. Kolff W.J, "Artificial Organs", John Wiley and sons, New York, 1976.
3. Albert M.Cook and Webster J.G, "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey,1982.

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REFERENCE BOOK:

1. D.S. Sunder, "Rehabilitation Medicine", Fourth Edition, Jaypee Medical Publication, 2020.

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Apply various mechanical techniques that will help failing heart	3		3										2	3	1
CO2	Analyze the functioning of the unit which does the clearance of urea from the blood	3		3										2	3	1
CO3	Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss	3		3										2	3	1
CO4	Make use of the concepts of orthotic devices and prosthetic devices	3		3										2	3	1
CO5	Illustrate the principles of TENS and Bio feedback	3												2	3	1

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COURSE OBJECTIVES:
- To study the working function of implantable stimulators.
- To learn about sensory instruments.
- To gain knowledge about various special equipment.
- To summarize different analytical instruments.
- To gain knowledge about in medical application

UNIT I   IMPLANTABLE STIMULATORS   9
Implantable Stimulators for Neuromuscular Control, block diagram, packaging of implantable electronics, leads and electrodes, safety issues of implantable stimulators, spinal fusion stimulator, Bladder stimulators, cerebellar stimulators, clinical use.

UNIT II   SENSORY INSTRUMENTS   9
Sound stimulators- Detection of evoked cortical potential, Measurement of average auditory evoked potential - Visually evoked potential measurement and application, somatosensory evoked potential, Brain mappers (EEG)- principles and measurements, Computerized tonometer, Keratometers.

UNIT III   SPECIAL EQUIPMENT   9
Impedance techniques: Bipolar and retrapolar circuits, detection of physiological activities usingimpedance techniques - cardiac output, neural activity, respiratory activity, impedance plethysmography- resistance and capacitance type. Spirometer.

UNIT IV   ANALYTICAL INSTRUMENTS   9
Advanced analytical aids - Fundamentals of NMR spectroscopy, X-ray spectrometers, mass spectrometers, Raman and Moss Beer spectroscopy. Blood Gas Analyzer, Automated Biochemical analysis Systems. Thermography – Principles and Recording. Auto analyzer.

UNIT V   APPLICATIONS OF MEDICAL EQUIPMENT   9
Brain–Computer interface, Pervasive Medical Care – Sports, Space, Military applications, Body Area Network. Smart phone based ECG monitoring system, Cloud computing technology in IoT,

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to::
CO1: Distinguish between neuromuscular stimulator and spine fusion stimulator.
CO2: Apply the concept of evoked potential response.
CO3: Infer about impedance technique
CO4: Construct biochemical analysis system
CO5: Develop cloud computing technology in medical application

TEXT BOOKS:
1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, Fifth Edition, 2020.
2. J. D. Bronzino, "The Biomedical Engineering Handbook- Vol. 1 & 2", CRC Press, Fourth Edition, 2015

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3. R.S. Kandhpur, "Handbook of Analytical Instrumentation", Tata McGraw Hill, Third Edition, 2015.

REFERENCE BOOKS:
1. John G. Webster, Haalit Eren, "The Measurement, Instrumentation & Sensors Handbook", Second Edition, CRC Press, 2014.
2. S. E. Sutphin, "Advanced Medical Instrumentation and Equipment", Prentice Hall, First Edition, 1987
3. John D. Enderle, Susan M. Blanchard, "Introduction to Biomedical Engineering", Academic Press, Third edition, 2011.
4. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, First edition, 2013.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Distinguish between neuromuscular stimulator and spine fusion stimulator	3					1							2	3	1
CO2	Apply the concept of evoked potential response	3		3			1				2			2	3	1
CO3	Infer about impedance technique	3		3			1		2		2			2	3	1
CO4	Construct biochemical analysis system	3		2			1		2		2	3		2	3	1
CO5	Develop cloud computing technology in medical application	3		1			1		2		2	3		2	3	1

PROJECT WORK   L   T   P   C
                                                              3   0   0   3

COURSE OBJECTIVES:
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL HOURS: 210 PERIODS

COURSES OUTCOMES:
Upon Completion of this course, students will be able to:

CO1: On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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