118PHT03	ENGINEERING PHYSICS	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		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	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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118CYT04	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

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.

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UNIT V FUELS AND COMBUSTION 9

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

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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: squareroot, 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 recourses 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

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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

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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 phenomenon of heat transfer through conductors and bad 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

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118PPP08	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		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

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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 toenvironmental 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 andsurface.

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.

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UNIT III ENVIRONMENTAL POLLUTION **10**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soilpollution (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

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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

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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

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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	

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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

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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

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218CDP09	CIRCUITS AND DEVICES LABORATORY	L	T	P	C
		0	0	2	1

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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SEMESTER III

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315MAT01	ENGINEERING MATHEMATICS – III	3	1	0	4	50	50	100

Course Objectives

- To develop z-transform techniques which analyze the discrete time signals.
- To solve certain linear differential equations using the Laplace transform technique which has applications in control theory and circuit theory.
- To introduce Fourier series analysis which is central to 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 in which the functions used are aperiodic.

UNIT I Z – TRANSFORM 9+3

z-transform - Elementary properties and applications - Inverse z-transform – Convolution theorem (statement and applications only) - Initial and final value theorems (Statement and applications only) - Solution of difference equations by applying z-transform using partial fractions, residue theorem and convolution theorem methods only.

UNIT-II LAPLACE TRANSFORM 9+3

Laplace transform – Conditions for existence –Basic properties (without proof) – Laplace Transform of elementary functions, derivatives and integrals, unit step function and impulse functions, periodic functions. Definition of Inverse Laplace transform – Convolution theorem (Statement and applications only) – Initial and final value theorems (Statement and applications only) – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transform techniques.

UNIT III 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 – Harmonic Analysis.

UNIT IV BOUNDARY VALUE PROBLEMS 9+3

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

UNIT V FOURIER TRANSFORM 9+3

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

TOTAL: 45+15=60 PERIODS

Course Outcomes

- Gaining the concept of analysis of linear discrete system using Z-transform approach.
- Applying Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields.

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- Describing an oscillating function which appear in a variety of physical problems by Fourier series helps them to understand its basic nature deeply.
- Acquiring the knowledge to construct partial differential equations for various physical and engineering real time problems and obtaining solution using Fourier series methods.
- Understanding the effect of Fourier transform techniques and their applications.

TEXT BOOK

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd edition , 2016.

REFERENCES

1. T.Veerarajan,"Engineering Mathematics-III", Tata McGraw-Hill Publishing company, New Delhi,2015.
2. V.Prameelakaladharan and G.Balaji ,"Engineering Mathematics-III", Amrutha marketing, Chennai,2016.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, " Engineering Mathematics-III", S.Chand Publishers,2015.

	Course Outcome	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	Gaining the concept of analysis of linear discrete system using Z-transform approach.	3	2												2	
CO2	Applying Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields.	3	2												2	
CO3	Describing an oscillating function which appears in a variety of physical problems by Fourier series helps them to understand its basic nature deeply. Acquiring the knowledge to construct partial differential	3	2	2	2										2	

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	equations for various physical and engineering real time problems and obtaining solution using Fourier series methods.															
CO4	Understanding the effect of Fourier transform techniques and their applications.	3	2	2	2										2	

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Course Code	Course Name	L	T	P	C	CA	EA	TOTAL
315GET02	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	3	0	0	3	50	50	100

OBJECTIVES

The student should be conversant with the evolution of environmentalism and the importance of environmental studies, various natural resources and the current threats to their sustainability, significance and protection of bio diversity and various forms of environmental degradation and international conventions and protocols for the protection of environment and concept of sustainability.

UNIT 1 INTRODUCTION TO ENVIRONMENT AND ECOSYSTEM 9

Definition, scope and importance of environment – need for public awareness. Atmosphere – composition of atmosphere (troposphere, stratosphere, mesosphere and thermosphere) Biosphere – Hydrosphere – Lithosphere. Concept of ecosystem – structure and functions of ecosystem-producers, consumers and decomposers - Energy flow –Ecological succession-Food chains-Food webs- Ecological pyramids-Introduction, types, characteristic features -structures and function of forest, grassland and aquatic ecosystems (ponds and rivers) - Case Studies in current scenario.

UNIT 2 NATURAL RESOURCES AND BIODIVERSITY 9

Forest resources-Water resources-Mineral resources-Food resources-Energy resources-Land resources. Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographically 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.

UNIT 3 ENVIRONMENTAL POLLUTION 9

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.

UNIT 4 SOCIAL ISSUES, HUMAN POPULATON AND THE ENVIRONMENT 9

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

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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 protection act –-environmental legislation-central and state pollution control boards.

UNIT 5 CONCEPT OF SUSTAINABLE DEVELOPMENT 9

Definition of sustainability -Components of sustainability History and emergence of the concept of sustainable development – Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment -Sustainability indicators-Hurdles to Sustainability.

COURSE OUTCOMES

1 To understand & appropriate the structure of ecosystem and its impact on environment.
2 To understand the various natural resources and boidiversity
3 To recognize the environmental problems caused due to pollution.
4 To understand the concept of sustainable development

TEXT BOOKS

1 Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition,
Pearson Education (2004).
2 Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill,NewDelhi,
(2006).

REFERENCES

1 R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2 Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ.,House, Mumbai, 2001.
3 Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi,2007.
4 Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press,(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	To understand & appropriate the structure of ecosystem and its impact on environment.	1	1				1	3						1		1
CO2	To understand the various natural resources and biodiversity							3						1		1
CO3	To recognize the environmental problems caused due to pollution.	1	1				1	3						1		1
CO4	To understand the concept of sustainable development	1					1	3						1		1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BMT03	LIFE SCIENCES-I	3	0	0	3	50	50	100

Subject Description: Professional Core
Pre-requisites: Nil
Course Objectives:

1. To understand the role of cell components in human physiology
2. To understand the importance of blood and related diseases.
3. To understand the principle functions of kidney, the regulation of respiration and human circulatory system.
4. To develop the basic knowledge of human sensory organs- eye and ear.
5. To understand Ossification and digestive systems.

UNIT I STUDY OF CELLULAR SYSTEM 10

Cell: Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane , Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Inflammation and Repair including fracture healing, Neoplasia, Tumor Classification, Benign and Malignant tumours, carcinogenesis.

UNIT II HEMATOLOGICAL SYSTEM 10

Blood composition - functions of blood – functions of RBC. WBC types and their functions. Blood groups –importance of blood groups –identification of blood groups. Thrombosis, embolism, infarction and shock, Bleeding disorders, Leukaemias, Lymphomas. Blood flow factors regulating blood flow such as viscosity, radius , density etc (Fahreus lindqvist effect, Poiseuille's Law).

UNIT III RENAL, RESPIRATORY AND CARDIAC SYSTEM 9

Structure of Kidney and nephron. Mechanism of Urine formation and acid base regulation. Components of respiratory system. Oxygen and carbon dioxide transport and acid base regulation. Structure of Heart – Properties of Cardiac muscle – Cardiac muscle - Cardiac cycle - Heart sound - Volume and pressure changes and regulation of heart rate.

UNIT IV SENSORY SYSTEM 8

Structure of a Neuron. Synaptic conduction. Conduction of action potential in neuron, Parts of brain cortical localization of functions. Simple reflexes , withdrawal reflexes. Autonomic nervous system and its functions, Structure of eye, ear and auditory and visual pathways.

UNIT V OSSIFICATION AND DIGESTIVE SYSTEM 8

Structure of Bones, functions of bones and joints. GIT- anatomy and physiology, oral cavity, oesophagus, stomach intestine, anus and rectum.

TOTAL: 45 PERIODS

Course outcomes:

1. Understood the importance of transport of substances across the cell membrane.
2. Gained knowledge of blood components in blood grouping and differential count analysis.

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3. Understood and implemented the knowledge on physiology of kidney, respiratory and cardiac cycle.
4. Understood the image formation and vision, sound perception and different types of deafness in the ears.
5. Known the significance of digestive system, various bones and joints.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	Understood the importance of transport of substances across the cell membrane.	3					1							3	2	1
CO2	Gained knowledge of blood components in blood grouping and differential count analysis.	3			1		1							3	2	1
CO3	Understood and implemented the knowledge on physiology of kidney, respiratory and cardiac cycle.	3			1		1							3	2	1
CO4	Understood the image formation and vision, sound perception and different types of deafness in the ears.	3					1							2	3	1
CO5	Known the significance of digestive system, various bones and joints	3					1							3	1	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BMT04	ANALOG ELECTRONICS	3	0	0	3	50	50	100

Subject Description: Professional Core

Pre-requisites: Fundamental Knowledge in Electron Devices is needed

Course Objectives:

1. To learn about different applications of diodes and different biasing techniques for BJT and FET.
2. To acquire the knowledge about the characteristics and operation of various analog IC'S
3. To study the application of analog IC'S for filter design
4. To learn the applications of analog ICs in converters.

UNIT I DIODE APPLICATIONS AND TRANSISTOR BIASING 9

Rectifiers – HWR, FWR, Bridge rectifier with and without capacitor and pie filter. voltage multiplier circuits - Operating point of the bi-polar junction transistor – Fixed bias circuit – Transistor on saturation – Emitter stabilized Bias Circuit – Voltage divider bias – Transistors switching network . Biasing the FET transistors - CMOS devices – MOSFET handling-Applications.

UNIT II IC FABRICATION 9

Basics of Integrated Circuits, IC classifications, fundamentals of monolithic IC technology, Basic Planar Processes, Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, transistor and FETs.

UNIT III OPERATIONAL AMPLIFIERS 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 of op-amp – inverting and noninverting 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 Half wave and full wave rectifiers – 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.

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

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

1. Got knowledge in Design circuits using diodes based on required output and apply suitable biasing circuits for BJT and FET.
2. Acquired the knowledge of inverting, non inverting amplifier, integrator and differentiator
3. Got the ability to design filters and signal generator circuits according to required output.
4. Learned the applications of analog ICs in converters.

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.

REFERENCES :

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-REFERENCE(S):

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

	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	Got knowledge in Design circuits using diodes based on required output and apply suitable biasing circuits for BJT and FET.	3	2	3	2										3	1
CO 2	Acquired the knowledge of inverting, non-inverting amplifier, integrator and differentiator	3	2	3	2										3	1
CO 3	Got the ability to design filters and signal generator circuits according to required output.	3	2	3	2										3	1
CO 4	Learned the applications of analog ICs in converters.	3	2	3	2										3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BMT05	DIGITAL ELECTRONICS	2	1	0	3	50	50	100

Subject Description: Professional Core

Pre-requisites: Fundamental Knowledge in Electron Devices is needed

COURSE OBJECTIVE:

1. To study various number systems and to simplify the mathematical expressions using Boolean functions –simple problems
2. To study the implementation of combinational circuits
3. To study the design of various synchronous and asynchronous circuits.
4. To get expose the students to various Programmable Logic Devices and memory.

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. Architecture of PLDs, Implementation of digital functions. Memories: Read only memories, PROMs, EROMs, EEPROMs, and RAMs: Static RAM, DynamicRAM, 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 logic family – Totem pole, Open collector and tristate outputs. MOS transistor switches –nMOS Inverter / Logic gates, CMOS Inverter / logic gates, ECL logic families, Comparison of performance of various logic families, Interfacing TTL and CMOS devices.

TOTAL:45 PERIODS

COURSE OUTCOMES:

1. Computed the Postulates of Boolean algebra using different techniques
2. Understood Designing the Combinational and sequential circuits
3. Understood the concept of memories and programmable logic device
4. Applied the concept of synchronous and asynchronous circuit

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TEXT BOOKS:

1. M. Morris Mano and Michael D. Cilette, "Digital Design", Prentice Hall, Fifth Edition, 2011
2. Thomas L Floyd, " Digital Fundamentals", Prentice Hall, 11th Edition, 2014.

REFERENCES:

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-REFERENCE(S):

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	Computed the Postulates of Boolean algebra using different techniques	3	2	3	2										3	1
CO2	Understood Designing the Combinational and sequential circuits	3	2	3	2										3	1
CO3	Understood the concept of memories and programmable logic device	3	2	3	2										3	1
CO4	Applied the concept of synchronous and asynchronous circuit	3	2	3	2										3	1

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Course Code	Course Title	Hours / Weeks			Credits	Maximum Mark		
		L	T	P	C	CA	EA	Tota
315BMT06	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING IN C++	3	0	0	3	50	50	100

Prerequisites: Fundamentals of Computing and C Programming

OBJECTIVES:

- Comprehend the Fundamentals of Object Oriented Programming in C++.
- Use Object Oriented Programming to Solve Real Time Problems.
- Learn the Linear Data Structures like Lists, Stacks and Queues.
- Get Familiar about the Non Linear Data Structures.
- Develop the Ability to use Sorting and Searching Algorithms Efficiently.

UNIT - I INTRODUCTION TO OBJECT ORIENTED PROGRAMMING 9

Evolution of Programming Paradigms - Structured vs. Object Oriented Development - Elements of Object Oriented Programming - Merits and Demerits - Classes and Objects - Function Components: Passing Data to Functions - Parameter Passing - Default Arguments - Inline Functions - Function Overloading - Friend Function - Constructors: Parameterized Constructors - Copy Constructors - Destructors - Array of Objects - this Pointer.

UNIT - II INHERITANCE, POLYMORPHISM AND EXCEPTION HANDLING 9

Operator Overloading: Unary Operator Overloading - Binary Operator Overloading - Data Conversion : Conversion between Basic Data Types - Inheritance - Types of Inheritance - Virtual Functions - Pure Virtual Function - Abstract Classes - Templates: Function Template - Class Template - Exception Handling: Exception Handling Model - Exception Handling Constructs - Handling Uncaught Exception.

UNIT - III LINEAR DATA STRUCTURES 9

Abstract Data Types - The List ADT - The Stack ADT - The Queue ADT - Priority Queues - Binary Heap - Binomial Queues.

UNIT - IV NON-LINEAR DATA STRUCTURES 9

Trees: Binary Trees - Binary Search Tree - AVL Trees - Tree Traversals - B-Trees – Graphs: Topological Sort - Graph Traversal: Depth First Search - Breadth First Search - Shortest Path

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Algorithm: Dijkstra's Algorithm - Minimum Spanning Tree: Prim's Algorithm - Kruskal's Algorithm.

UNIT - V SORTING AND SEARCHING 9

Insertion Sort - Shell Sort - Heap Sort - Merge Sort - Quick Sort - Selection Sort - Bucket Sort - External Sorting - Linear Search - Binary Search.

Total Hours: 45

COURSE OUTCOMES:

At the End of the Course the Students will be able to,

1. Gain the basic knowledge on Object Oriented Programming.
2. Develop Applications, and Implement Features of Object Oriented Programming to Solve Real World Problems.
3. Implement various Abstract Data Types to Solve Real Times Problems by using Linear Data Structures.
4. Apply the different Non-Linear Data Structures to Problem Solutions.
5. Analyze and Implement various Sorting and Searching Algorithms.

TEXT BOOKS:

1. K. R. Venugopal, Rajkumar Buyya, "MASTERING C++" 2E, Tata McGraw Hill, New Delhi, 2013.

2. Mark Allen Weiss, DATA STRUCTURES AND ALGORITHM ANALYSIS IN C++", 4/E Pearson Education, 2013.

3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "FUNDAMENTALS OF DATA STRUCTURES IN C++", Computer Science Press, New York, 2007

REFERENCES:

1. Rohit Khurana, "DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING WITH C++ ", First Edition, Vikas Publishing House Pvt Ltd, 2012.

2. Bhushan Trivedi, "PROGRAMMING WITH ANSI C++, A Step-By-Step Approach", Oxford University Press, 2010.

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	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Gain the basic knowledge on Object Oriented Programming.			3	2							3			2	1
CO2	Develop Applications, and Implement Features of Object Oriented Programming to Solve Real World Problems.			3	2	3						2			2	1
CO3	Implement various Abstract Data Types to Solve Real Times Problems by using Linear Data Structures.			3	2	3						3			2	1
CO4	Apply the different Non-Linear Data Structures to Problem Solutions.					3						3			2	1
CO5	Analyze and Implement various Sorting and Searching Algorithms					3									2	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315BMP07	LIFE SCIENCES-I LAB	0	0	4	2	50	50	100

Subject Description: Professional Core
Pre-requisites: Nil

Course Objectives:

1. To understand the tumors and other diseases caused by blood deficiency.
2. To gain knowledge on blood related diseases.
3. To gain knowledge on eye tests and audiogram tests.

LIST OF EXPERIMENTS:

1. Microscope with neubauer chamber.
2. Estimation of differential count.
3. ESR , PCV , MCH, MCV, MCHC, total count of RBCs and Hemoglobin estimation
4. Blood grouping/ osmotic fragility.
5. Bleeding time/ clotting time.
6. Weber's and Rinnee's test for auditory conduction.
7. Ishihara chart for color blindness.
8. Histopathological slides of benign and malignant tumours.
9. Haematology slides of anemia and leukemia
10. Opthalmascope for eyespot detection

TOTAL: 45 PERIODS

Course Outcomes:

1. Understood of how eye tests are conducted
2. Demonstrated the contents of blood and how to analyze it
3. Demonstrated an understanding of how audiogram tests are conducted
4. Compared various blood related diseases.

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	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understood of how eye tests are conducted	3		2	3					1				3	3	1
CO2	Demonstrated the contents of blood and how to analyze it	3		2	3					1				3	3	1
CO3	Demonstrated an understanding of how audiogram tests are conducted	3		2	3					1				3	3	2
CO4	Compared various blood related diseases.	3		2	3					1				3	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
311BMP08	ANALOG & DIGITAL ELECTRONICS LAB	0	0	4	2	50	50	100

Subject Description: Professional Core
Pre-requisites: Fundamental Knowledge in Circuits and Devices Lab is needed
Course Objectives:

1. To enhance the students about the areas where the simple electronic components are being used
2. To acquire the knowledge about the characteristics and operation of analog IC 741
3. To design filter circuits, oscillators and wave form generators.
4. To design analog circuits for biomedical applications.

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. Instrumentation amplifier using IC741
9. Wein bridge oscillator
10. Multivibrator using IC555 Timer
11. Study of logic gates, Half adder and Full adder
12. Encoder and BCD to 7 segment decoder
13. Multiplexer and demultiplexer using digital ICs
14. Universal shift register using flipflops
15. Design of mod-N counter
16. Design of analog circuits for biomedical applications

TOTAL: 45 PERIODS

Course Outcome:

1. Understood the practical application of various electronic circuits like rectifiers, amplifiers.
2. Acquired the designing knowledge of linear and non-linear applications of IC 741
3. Gained knowledge in design of filter circuits, oscillators and wave form generators.
4. Gained knowledge in analog circuits for biomedical applications.

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	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understood the practical application of various electronic circuits like rectifiers, amplifiers.	3	3	3	3										3	2
CO2	Acquired the designing knowledge of linear and non-linear applications of IC 741	3	3	3	3										3	2
CO3	Gained knowledge in design of filter circuits, oscillators and wave form generators.	3	3	3	3										3	2
CO4	Gained knowledge in analog circuits for biomedical applications.	3	3	3	3										3	2

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Course Code	Course Title	Hours / Weeks L	T	P	Credits C	Maximum Marks CA	EA	Total
315BMP09	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING IN C++ LAB	0	0	4	2	50	50	100

Prerequisites: Fundamentals of Computing and C Programming Lab

OBJECTIVES:

- Be familiar with the Basic and Advanced Concepts of C++.
- Identify and Practice the Object Oriented Programming Concepts and Techniques.
- Efficiently implement the different Linear Data Structures.
- Learn and Expose Non-Linear Data Structures.
- Learn to implement Sorting and Searching Algorithms.

C++ PROGRAMS:

1. Passing Default Arguments.
2. Inline Function and Friend Function.
3. Constructor and Destructor.
4. Array of Objects.
5. Function Overloading and Operator Overloading.
6. Data Conversion.
7. Inheritance.
8. Virtual Functions and Templates.

DATA STRUCTURE USING C++:

9. Implementation of Linked List, Stack, and Queue.
10. Implementation of Binary Search Tree.
11. Implementation of AVL Tree.
12. Implementation of Shortest Path Algorithm.
13. Implementation of Minimum Spanning Tree.
14. Implementation of Sorting Algorithms.
15. Implementation of Searching Algorithms.

COURSE OUTCOMES:

At the End of the Course the Students will be able to,

CO1: Implement basic and advanced concepts of Object Oriented Programming using C++
CO2: Apply Good Programming Design methods for Program Development using Object Oriented Concepts.
CO3: Design and implement C++ programs for manipulating Stacks, Queues, Linked Lists.

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CO4: Apply the different Non-Linear Data Structures for Implementing Solutions to Practical Problems.
CO5: Analyze and Implement various Searching and Sorting Algorithms.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Implement basic and advanced concepts of Object Oriented Programming using C++			3						3					2	1
CO2	Apply Good Programming Design methods for Program Development using Object Oriented Concepts.			3		3				2					2	1
CO3	Design and implement C++ programs for manipulating Stacks, Queues, Linked Lists.			3		3				3					2	1
CO4	Apply the different Non-Linear Data Structures for Implementing Solutions to Practical Problems.					3				3					2	1
CO5	Analyze and Implement various Searching and Sorting Algorithms.					3									2	

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Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
415ECT02	SIGNALS AND SYSTEMS	3	1	0	4	50	50	100

COURSE OBJECTIVES:

Demonstrate an understanding of the fundamental properties and representation of discrete and continuous time signals.

- Spectral analysis of CT periodic and aperiodic signals using CT Fourier and Laplace methods.
- Analysis and Characterization of total response, impulse response and frequency response of LTI CT systems.
- Use Discrete Time Fourier Transforms and Z transform to analyze discrete time signals. Analysis and Characterization of total response, impulse response and frequency response of LTI DT systems.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9+3

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+3

Fourier Series Analysis, Spectrum of CT Signals, 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+3

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

UNIT IV ANALYSIS OF DT SIGNALS 9+3

Spectrum of DT Signals, 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+3

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

Total Hours: 60

Course Outcomes

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

1. Categorize the properties and representation of discrete and continuous time signals.
2. Analyze the continuous time signal using Fourier and Laplace transform.
3. Determine total response, impulse response and frequency response of LTI-CT systems
4. Analyze the discrete time signals using Discrete Time Fourier Transforms and Z transform
5. Determine total response, impulse response and frequency response of LTI-DT Systems

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
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 of LTI-DT Systems	3	3	1	2									1	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BMT03	SENSORS AND MEASUREMENTS	3	0	0	3	50	50	100

Subject Description: Professional Core

Pre-requisites: Fundamental Knowledge in Analog Electronics is needed

Course Objectives:

1. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
2. Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
3. Know the different types of signal conditioners and analyzers.
4. Know the different display and recording devices.

UNIT I SCIENCE OF MEASUREMENT **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: 45 PERIODS

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Course Outcomes:

CO1: Described the purpose and methods of measurements

CO2: Understood the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.

CO3: Studied different types of signal conditioners and analyzers.

CO4: Explained 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, 1989.

REFERENCES

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2007.
2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.

	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Described the purpose and methods of measurements	2	2	2	2									3	2	1
CO2	Understood the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.	2	2	2	2									3	2	1
CO3	Studied different types of signal conditioners and analyzers.	2	2	2	2									3	2	1
CO4	Explained different display and recording devices for various applications.	2	2	2	2									3	2	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BMT04	MEDICAL PHYSICS	3	0	0	3	50	50	100

Subject Description: Professional Core

Pre-requisites: Fundamental Knowledge in Engineering & Applied Physics is needed

Course Objectives:

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

UNIT I INTRODUCTION 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

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UNIT IV PHYSICS OF CARDIOPULMONARY SYSTEM 9

The Airways, - blood and lung interaction – measurement of lung volume – pressure air flow volume relationships 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

UNIT V RADIATION EFFECTS 9

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: 45 PERIODS

Course Outcomes:

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

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

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

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

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.

REFERENCES

1. John R. Cameron and James G. Skofronick, "Medical Physics", John–Wiley & Sons, 1978.
2. P.Uma Devi, A. Nagarathnam, B S Satish Rao, "Introduction to Radiation Biology" B.I .Churchill Livingstone Pvt ltd, 2000.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Studied the principles of light, sound and ultrasound and its properties and about the non-ionizing radiation and their effects	3			1										2	1
CO2	Understood various types of spontaneous radioactive emissions and various methods of producing radionuclides.	3			1									2	1	
CO3	Understood various types of interaction of charged particles with matter and the effects due to interaction of gamma radiation with matter and their characteristics	3			1									2	1	2
CO4	Studied about the mechanical characteristics of lungs and cardiopulmonary system and application of Bernoulli's principle to cardiovascular system	3			1									2	1	2

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BMT05	LIFE SCIENCES-II	3	0	0	3	50	50	100

Subject Description:Professional Core

Pre-requisites: Fundamental Knowledge in Life Sciences - I is needed

Course Objectives:

1. To have a sound knowledge on classification, structure and properties of carbohydrates, lipids and amino acids and their functions
2. To know about the overview of central metabolic pathways; the classification of enzymes and their general effects and regulation.
3. To know about the various biochemical analysis to be done in the biofluids and different equipments used for the analysis purpose.

UNIT I CHEMICAL CONSTITUENTS AND MOLECULAR BIOLOGY 9

Introduction to Biochemistry – Biomolecules – Classification, Structure & Properties of Carbohydrates, Proteins, Lipids. Composition & Functions of Nucleic acids – DNA Structure & its applications. Enzymes – Chemical nature, Properties, Enzymes in clinical diagnosis of diseases.

UNIT II HORMONES AND METABOLISM 9

Hormones – General Characteristics, Structure, Function & Disorders. Assay of Hormones – Immunoassay - RIA & ELISA. Use of Radio isotopes in Biochemistry. Metabolism – Carbohydrate metabolism, Lipid metabolism, TCA Cycle, Electron Transport & Oxidative Phosphorylation.

UNIT III CLINICAL BIOCHEMISTRY 9

Liver Function and Liver Function tests, Renal Function and Renal Function tests, Normal & Abnormal constituents of urine and their clinical significance.Analytical Techniques – Purification of Protein by Chromatography & Electrophoresis.

UNIT IV TOOLS OF BIOCHEMISTRY 9

Principles & Application of Photometry, Spectrophotometry, Fluorimetry, Colorimetry, pH-metry, Nephlometry, Turbidimetry, Cetrifugation, Automation in Biochemical Analysis.

UNIT V INTRODUCTION TO MICROBIOLOGY 9

General Structural Organisation of bacterial and viral cell- growth and identification of bacteria, observation of culture. Viral disease – Immune deficiency syndrome.

Microscopy: Light microscopy, dark field microscopy, phase contrast microscopy, fluorescence and electron microscopy.

TOTAL: 45 PERIODS

Course Outcomes:

CO1: Demonstrated a qualitative and quantitative understanding of major biomolecules such as carbohydrates, lipids and proteins.

CO2: Recognized and explain the basic features of chromatography and electrophoresis

CO3: Demonstrated an understanding of the fundamental principles microscopes.

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TEXT BOOKS:

1. Satyanarayana U., Chakrapani U., "Biochemistry", Elsevier, 4th edition, 2013.
2. Ananthanarayanan R. & Panicker CKJ, "Textbook of Microbiology". Orient Longmans, 7th edition.2006.

REFERENCE BOOKS:

1. Pamela.C.Champe & Richard. A.Harvey, "Biochemistry Lippincott's Illustrated Reviews", Lippincott-Raven publishers, 4th edition, 2007.
2. Prescott, Harley, Klein, "Microbiology", Mc Graw Hill 7th edition. 2007.
3. David. W. Martin, Peter. A. Mayes, Victor. W. Rodwell, "Harper's review of biochemistry", Lange Medical Publications, 20th edition, 1985.
4. Dubey RC and Maheswari DK, "A textbook of Microbiology", S Chand, 3rd edition 2013.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Demonstrated a qualitative and quantitative understanding of major biomolecules such as carbohydrates, lipids and proteins.	3			1		1							3	1	1
CO2	Recognized and explain the basic features of chromatography and electrophoresis	3			1		1							3	1	1
CO3	Demonstrated an understanding of the fundamental principles microscopes.	3			1		1							3	1	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BMT06	ELECTRICAL MACHINES	3	0	0	3	50	50	100

Subject Description: Professional Core

Pre-requisites: Fundamental Knowledge in Electrical Circuits & Electron Devices is needed

Course Objectives:

At the end of this course, student would have been exposed to:

1. Theory of structures, operating principle, characteristics, and applications of D.C and A.C rotating machines and transformers in detail.
2. Introductory knowledge on Special Machines.

UNIT – I 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 – II TRANSFORMERS **9**

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

UNIT – III SYNCHRONOUS MACHINES **9**

Principle of alternators:-Constructional details, Equation of induced EMF and Vector diagram - Synchronous motor:- Starting methods, Torque, V curves, Speed control and Hunting.

UNIT - IV INDUCTION MOTOR **9**

Induction motor:- Construction and principle of operation, Classification of single phase and three phase induction motor, Torque equation, Condition for maximum torque, Equivalent Circuit, 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: 45 PERIODS

Course Outcomes:

CO1: Understood the construction, working, characteristics and applications of DC generators & DC motors, testing of single phase transformers

CO2: Understood the theory of structures, operating principle, characteristics, and applications of A.C rotating machines in detail

CO3: Gained the basic knowledge on Special Machines

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TEXT BOOKS:

1. Nagrath.I.J. &Kothari.D.P, "Electrical Machines", Tata McGraw-Hill, New Delhi, 5th edition 2012.
2. 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Understood the construction, working, characteristics and applications of DC generators & DC motors, testing of single phase transformers	3	2		3										3	
CO2	Understood the theory of structures, operating principle, characteristics, and applications of A.C rotating machines in detail	3		3											3	
CO3	Gained the basic knowledge on Special Machines	3		3											3	

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	LIFE SCIENCES II	L	T	P	C	CA	EA	Total
415BMP08	LAB	0	0	4	2	50	50	100

Subject Description: Professional Core

Pre-requisites: Fundamental Knowledge in Life Sciences - I Lab is needed

Course Objectives:

4. To learn the laboratory analysis of carbohydrates, lipids and proteins qualitatively and quantitatively
5. To provide basic training in biochemical techniques such as chromatography and electrophoresis
6. To learn fundamental approaches for experimentally investigating biochemical problems

LIST OF EXPERIMENTS:

1. General tests for carbohydrates, proteins and lipids.
2. Preparation of serum and plasma from blood.
3. Estimation of blood glucose.
4. Estimation of serum cholesterol.
5. Assay of SGOT/SGPT.
6. Estimation of creatinine in urine.
7. Electrophoresis of serum proteins.
8. Separation of amino acids using paper chromatography.
9. Slides of malyarial parasites, micro filaria and leishmania donovani.
10. Study of bone marrow charts.
11. Acid fast staining.

TOTAL : 45 PERIODS

Course Outcomes:

CO1: Demonstrated a qualitative and quantitative understanding of major biomolecules such as carbohydrates, lipids and proteins

CO2: Recognized and explained the basic features of chromatography and electrophoresis

	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Demonstrated a qualitative and quantitative understanding of major biomolecules such as carbohydrates, lipids and proteins	3		2	3									2	2	3
CO2	Recognized and explained the basic features of chromatography and electrophoresis	3		2	3									2	1	3

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BMP09	SENSORS AND MEASUREMENTS LAB	0	0	4	2	50	50	100

Subject Description:Professional Core

Pre-requisites: Fundamental Knowledge in Analog & Digital Electronics Lab is needed

Course Objectives:

1. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.
2. Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.
3. Know the different display and recording devices.

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. Hall effect transducer
14. Characteristics of strain gauge
15. Study of Smart sensors

TOTAL: 45 PERIODS

Course Outcomes:

CO1: Described the purpose and methods of measurements

CO2: Explained different display and recording devices for various applications.

***Inplant Training** - Students will undergo two weeks of Inplant Training during fourth semester summer vacation.

	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	PS O1	PS O2	PS O3
CO1	Described the purpose and methods of measurements	1	2	2	1									2	3	1
CO2	Explained different display and recording devices for various applications.	1	2	2	1									2	3	1

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Professional Elective – I

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415BME07	ELECTRO MAGNETIC THEORY	3	0	0	3	50	50	100

Subject Description:Professional Elective

Prerequisite: Nil

Course Objectives:

1. To introduce the basic mathematical concepts related to electromagnetic fields.
2. To understand the concepts of Electrostatics.
3. To understand the concepts of Magneto statics.
4. To understand the concept of Electromagnetic Fields,
5. To understand the concepts of waves and wave propagation.

UNIT – I INTRODUCTION 9

Introduction: Co-ordinate systems and transformation, Cartesian coordinates, Circular cylindric coordinates, Spherical coordinates & their transformation. Differential length, area and volume i different coordinate systems. Numerical problems.

Vector calculus: DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Stokes theorem, Classification of vector fields, Numerical problems.

UNIT - II ELECTROSTATIC FIELD 9

Coulomb's law, field intensity, Gauss's law and applications, Electric potential and Potential gradient, Relation between E and V, Electric dipole and flux lines. Energy density in electrostatic field. Boundary conditions: Dielectric-dielectric, Conductor-free space. Poisson's and Laplace's equation. Numerical problems.

UNIT - III MAGNETO STATIC FIELDS 9

Biot- savart law, Ampere's circuital law, Magnetic flux density, Magnetic scalar and Vector potential, magnetic field intensity: Infinitely straight conductor, circular coil. Magnetic torque, Magnetic material, Magnetic boundary condition, Inductor and Inductances, Magnetic energy density. Numerical problems.

UNIT - IV ELECTROMAGNETIC FIELDS 9

Faraday's law, Induced emf-Transformer and motional emf, Displacement current, Maxwell's equations, Maxwell's equations in differential and integral form. Relation between field theory and circuit theory. Numerical problems

UNIT - V ELECTROMAGNETIC WAVE PROPAGATION 9

Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power & Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarization. Numerical problems

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TOTAL: 45 PERIODS

Course Outcomes:

CO1: Understood the coordinate systems and learn mathematical operations related to fields.
CO2: Understanding Coulomb's law and Gauss's law and applications of these laws in analyzing electrostatic fields.
CO3: Understood the properties of materials under the influence of electric field. Deriving Poisson's and Laplace's equations and learn general procedures for solving these equations.
CO4: Understood Biot-Savart's Law and Ampere's Circuital law and applications of these laws in analyzing magnetic fields.
CO5: Understood the Maxwell's equations and principles of propagation of uniform plane waves in different media.

TEXT BOOKS:

1. Elements of Electromagnetic, Mathew N.O. Sadiku, 4th edition, Oxford university press. 2007
2. Engineering Electromagnetic, William. H. Hayt & J.A. Buck, 7th Edition, TMH, 2001
3. Theory and problems of Electromagnetic, Edminister, 2nd Edition, TMH, 1993
4. Electromagnetic field theory fundamentals, Guru & Hizroglu, 2nd edition, Cambridge University Press.2000

REFERENCES

1. Electromagnetic with application, Krause, 5th Edition, TMH. 1999.
2. Elements of Engineering Electromagnetic, N.N. Rao, 6th Edition, Pearson Education 2000.
3. K. A. Gangadhar and P. M. Ramanathan, 'Electromagnetic Field Theory', Khanna Publishers, Delhi 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	PS O1	PS O2	PS O3
CO1	Understood the coordinate systems and learn mathematical operations related to fields.	3	3	3	3										3	1
CO2	Understanding Coulomb's law and Gauss's law and applications of these laws in analyzing electrostatic fields.	3	3	3	3										3	1
CO3	Understood the properties of materials under the influence of electric field. Deriving Poisson's and Laplace's equations	3	3	3	3										3	1

	and learn general procedures for solving these equations.															
CO4	Understood Biot-Savart's Law and Ampere's Circuital law and applications of these laws in analyzing magnetic fields.	3	3	3	3										3	1

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SEMESTER V

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BMT01	BIOMEDICAL INSTRUMENTATION	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Analog & Digital Electronics**

Course Objectives:

At the end of the course, the students should be able to:

1. Understand the origin of biopotentials & different types of electrodes used in biopotential recording
2. Know the different lead configurations used for recording biosignals like ECG, EEG, EMG, ERG & EOG.
3. Understand the need for bioamplifiers and different types of bioamplifiers.
4. Know the instrumentation concerned with measuring the non electrical parameters.
5. 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 ELECTRODE CONFIGURATIONS 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 AMPLIFIER 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, Transimpedance amplifier, Power line interference.

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETER 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, pO2 and pCo2, 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: 45 PERIODS

Course Outcomes:

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

1. Summarize different types of electrodes used in biopotential recording
2. Analyze the different lead configurations used for recording biosignals like ECG, EEG, EMG, ERG & EOG.
3. Understand the need for bioamplifiers and different types of bioamplifiers.
4. Know the instrumentation concerned with measuring the non electrical parameters.
5. Know the chemical sensors and analyzers.

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
2. John G. Webster, "Medical Instrumentation Application and Design", Fourth Edition, John Wiley and sons, New York, 2009

REFERENCES

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
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.

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Understood the origin of biopotentials & different types of electrodes used in biopotential recording	3		3	2									1	3	1
CO2	Known the different lead configurations used for recording biosignals like ECG, EEG, EMG, ERG & EOG.	3		3	2									2	3	1
CO3	Understood the need for bioamplifiers and different types of bioamplifiers.	3		3	2	1								2	3	1
CO4	Known the instrumentation concerned with measuring the non-electrical parameters.	3		3	2	1									2	1
CO5	Known the chemical sensors and analyzers.	3		3	2	1									3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515ECT02	DIGITAL SIGNAL PROCESSING	3	1	0	4	50	50	100

Designation: Professional Core **Pre-requisites: Signals & Systems**

Course Objectives:

At the end of the course, the students should be able to:

1. Compute FFT of a discrete time signal.
2. Design the various FIR filter techniques.
3. Design the various IIR filter techniques.
4. Analyze the finite word length effects in signal processing.
5. Devise the fundamentals of digital signal processors.

UNIT I FAST FOURIER TRANSFORM **9+3**

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.

UNIT II FINITE IMPULSE RESPONSE DIGITAL FILTERS **9+3**

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.

UNIT III INFINITE IMPULSE RESPONSE DIGITAL FILTERS **9+3**

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.

UNIT IV FINITE WORD LENGTH EFFECTS **9+3**

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-deadband-Overflow error-signal scaling.

UNIT V DIGITAL SIGNAL PROCESSOR TMS320C54X **9+3**

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: 60 PERIODS

Course Outcomes:

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

1. Calculate the FFT of a discrete time signal.
2. Demonstrate various FIR filter techniques.
3. Demonstrate various IIR filter techniques.

4. Summarize finite word length effects in signal processing.
5. Explain the fundamentals of Digital signal processor.

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.

REFERENCES

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	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Computed FFT of a discrete time signal.	3	3	0	3	2									3	1
CO2	Designed the various FIR filter techniques.	3	3	0	3	2									3	1
CO3	Designed the various IIR filter techniques.	3	3	0	3	2									3	1
CO4	Analyzed the finite word length effects in signal processing.	2	2	0	3	2									2	1
CO5	Devised the fundamentals of digital signal processors.	3	3	0	3	2									2	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515ECT03	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Digital electronics**

Course Objectives:

At the end of the course, the students should be able to:

1. Summarize the architecture and assembly language programming of microprocessors
2. Defend the architecture and assembly language programming of microcontrollers
3. Demonstrate the concept of interrupts and interfacing with various peripherals.
4. Integrate the features of a microcontroller and its timer applications.
5. Justify the architectural features of PIC with 8051 microcontroller

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 8255,7-Segment display.

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.

TOTAL: 45 PERIODS

Course Outcomes:

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

1. Recognize the basic Microprocessor architecture and its concepts.
2. Outline the concepts of peripheral interfacing mechanisms.
3. Design various assembly language programming using microprocessors and microcontroller.
4. Extend the real world interfacing with microcontroller
5. Extrapolate the architecture of PIC microcontroller and its addressing modes.

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	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Understood the architecture and assembly language programming of microprocessors	1	3	3	3	2									3	2
CO2	Understood the architecture and assembly language programming of microprocessor and peripheral interfacing mechanism	1	3	3	3	2									3	2
CO3	Learnt the concept of interrupts.	1	3	3	3	2									3	2
CO4	Learnt about interfacing the microcontroller with real time applications.	1	3	3	3	2									3	2
CO5	Understood the architectural features of PIC	1	3	3	3										3	2

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	BIOCONTROL	L	T	P	C	CA	EA	Total
515BMT04	SYSTEMS	3	1	0	3	50	50	100

Subject Description: Professional Core **Pre-requisites: Nil**

Course Objectives:

At the end of the course, the students should be able to:

1. Understand system concept and different mathematical techniques applied in analyzing any given system.
2. Analyze a given system in time domain and frequency domain.
3. Understand the techniques of plotting the responses in both domain analysis.
4. Apply time and frequency domain analysis to study the biological systems.
5. Simulate the control system components using MATLAB.

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 using MATLAB, 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, definition of gain margin and phase margin, Bode plot, Bode plot using Simulink, determination of gain margin and phase margin using 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, Lung mechanics model using Simulink, Case Studies.

TOTAL : 45 PERIODS

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Course Outcomes:

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

1. Understand system concept and different mathematical techniques applied in analyzing any given system.
2. Analyze a given system in time domain and frequency domain.
3. Understand the techniques of plotting the responses in both domain analysis.
4. Apply time and frequency domain analysis to study the biological systems.
5. Simulate the control system components using MATLAB.

TEXT BOOKS

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

REFERENCES

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	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Understood system concept and different mathematical techniques applied in analyzing any given system.	3	3	3	3									2	3	1
CO2	Analyzed a given system in time domain and frequency domain.	3	3	3	3									1	3	1
CO3	Understood the techniques of plotting the responses in both domain analysis.	3	3	2	1										2	1
CO4	Known the concept of stability and stability analysis.	3	3	3	2									2	3	1
CO4	Applied time and frequency domain analysis to study the biological systems.	3	3	3										1	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BMT05	ANALOG AND DIGITAL COMMUNICATION	3	0	0	3	50	50	100

Subject Description: Professional Core
Pre-requisites: Fundamental Knowledge in Analog and Digital Electronics is needed
Course Objectives:

At the end of the course, the students should be able to:

1. Understand different amplitude and frequency modulation/demodulation techniques.
2. Understand various pulse modulation techniques.
3. Acquire knowledge on different phase shift keying techniques and methods.
4. Learn the basics of information theory and different coding and decoding methods.
5. Know the recent trends in wireless technology.

UNIT I ANALOG MODULATION **9**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, 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

UNIT III DIGITAL MODULATION AND TRANSMISSION **9**

Phase shift keying – BPSK, DPSK, 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 decoding

UNIT V WIRELESS COMMUNICATION SYSTEMS **9**

Commercial Cellular / 3G networks, satellites, wireless sensor networks, wireless personal area networks : Body LAN-Bluetooth, Zigbee-Wireless LANs, Internet-Wifi-WiMax, Case study: IEEE 802.11A Wireless LAN Standard.

TOTAL: 45 PERIODS

Course Outcomes:

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

1. Apply different amplitude and frequency modulation/demodulation techniques.
2. Analyze various pulse modulation techniques.
3. Apply different phase shift keying techniques and methods.
4. Summarize the information theory and different coding and decoding methods.
5. Apply the wireless technology in real time systems.

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TEXT BOOK:

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

REFERENCES:

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	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understood modulation and demodulation techniques.		3	2	1										2	
CO2	Understood various pulse modulation techniques.		3	2	1										2	
CO3	Acquired knowledge on different phase shift keying techniques.		3	2	1										2	
CO4	Learnt the basics of coding and decoding methods.		3	2	1										2	
CO4	Known the recent trends in wireless technology.		3	2	1										2	

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Course Code	Course Name	L	T	P	C	CA	EA	Total
515BOE06	VIRTUAL INSTRUMENTATION	3	0	0	3	50	50	100

COURSE OBJECTIVE:

- 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 virtual Instrumentation- Virtual Instrumentation for test , Control and Design- Virtual Instrumentation in the Engineering

UNIT II Lab VIEW 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 and timers-Instrument control: **VISA,** GPIB, VXI and PXI.

UNIT V Lab VIEW APPLICATIONS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Learn the virtual instrumentation fundamentals.
2. Familiarize with the VI software and learn programming in VI
3. Understand various programming techniques.

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4. Understand various Instrument Interfacing and data acquisition methods.
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

	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Learn the virtual instrumentation fundamentals.	1	2	2	2	3								2	3	1
CO2	Familiarize with the VI software and learn programming in VI	1	2	2	2	3								2	3	1
CO3	Understand various programming techniques.	1	2	2	2	3								2	3	1
CO4	Understand various Instrument Interfacing and data acquisition methods.	1	2	2	2	3								2	3	1
CO5	Develops programs for Process control applications	1	2	2	2	3								2	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BMP07	BIO MEDICAL INSTRUMENTATION LAB	0	0	4	2	50	50	100

Subject Description: Professional Core

Course Objectives:

At the end of the course, the students should be able to:

1. Learn the sources of bio-potentials in the human body e.g. ECG, Pulse rate etc.
2. Understand different lead configurations used for recording biosignals like ECG, EEG, EMG.
3. Design the bioamplifiers.
4. Know the chemical sensors and analyzers.
5. Know about the safety and performance standards for biomedical instruments.

LIST OF EXPERIMENTS

1. Study of Biological Preamplifiers.
2. Recording of ECG signal and Analysis.
3. Recording of Audiogram.
4. Recording of EMG.
5. Recording of EEG.
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. Design of Digital Blood Pressure Monitor
11. Mini project.

Total: 45 Periods

Course Outcomes:

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

1. Analyze the sources of bio-potentials in the human body e.g. ECG, Pulse rate etc.
2. Record biosignals like ECG, EEG, EMG.
3. Design the bioamplifiers.
4. Measure pH, pO2, conductivity etc.
5. Understand the safety and performance standards for biomedical instruments.

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Recorded the biosignals like ECG, EEG, EMG.	3	2	3	3										3	2
CO2	Recorded the various physiological parameters.	3	2	3	2										2	3
CO3	Measured nonelectrical parameters using the chemical sensors.	3	2	3	2										3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515ECP08	MICROPROCESSORS AND MICROCONTROLLERS LAB	0	0	4	2	50	50	100

Subject Description: Professional Core

Course Objectives:

At the end of the course the student should be able to

1. Develop the code in assembly language programming.
2. Test the developed code using 8085, 8086 processors and 8051 controllers.
3. 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

1. Generate the code for arithmetic operations in assembly language
2. Generalize the developed code using 8085, 8086 processors and 8051 controllers
3. Reorganize the Interfacing peripherals with microprocessor and micro controller

TOTAL: 45 PERIODS

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	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Developed the code in assembly language programming.	3	1	3	3	2						3			3	2
CO2	Tested the developed code using 8085, 8086 processors and 8051 controllers.	3	1	3	3	2						3			3	2
CO3	Demonstrated the interface peripherals with microprocessor and micro controller	3	1	3	3	2						3			3	2

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515BMP09	DIGITAL SIGNAL PROCESSING LAB	0	0	4	2	50	50	100

Subject Description: Professional Core

Course Objectives:

At the end of the course the student should be able to

1. Compute FFT and IFFT of a discrete time signal.
2. Design and analyze the various FIR filter techniques
3. Design and analyze the various IIR filter techniques
4. Demonstrate Finite word length effects
5. 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

Course Outcomes:

Upon completion of this course, students will be able to

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

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Computed FFT and IFFT of a discrete time signal.	1	1		3	3						2			3	1
CO2	Designed and analyzed the various FIR filter techniques	1	1		3	3						2			3	1
CO3	Designed and analyzed the various IIR filter techniques	1	1		3	3						2			3	1
CO4	Demonstrated Finite word length effects	1	1		3	3									3	1
CO4	Analyzed the Biomedical signals	1	1		3	3						2			3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BMT01	DIAGNOSTIC EQUIPMENT	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Biomedical Instrumentation**

Course Objectives:

1. To study the genesis and variation in ECG waveform
2. To study genesis and recording of EEG signals.
3. To understand structure, method of muscle contraction, generation of EMG signals.
4. To understand about the different Psycho Physiological Measurements and about EOG, ERG
5. To understand the use of an audiometer and the GSR

UNIT I CARDIAC EQUIPMENT **9**

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor,Arrhythmia Simulator, Holter Monitor, Phonocardiography, Plethysmography.

UNIT II NEUROLOGICAL EQUIPMENTS **9**

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

UNIT III SKELETAL MUSCULAR SYSTEM **9**

Sliding theory of contraction, recording and analysis of EMG waveforms, fatigue characteristics , Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

UNIT IV RESPIRATORY MEASUREMENT STSTEM **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, Apnea Monitor. Types of Ventilators – Pressure, Volume, Time controlled flow

UNIT V SENSORY MEASUREMENT **9**

Psycho Physiological Measurements-for testing and sensory Responses, Electroocculograph, Electroretinograph, Audiometer-Puretone, Speech. EGG Electro gastrograph), galvanic skin resistance (GSR). Principles of Cryogenic technique and application, Endoscopy

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TOTAL : 45 PERIODS

Course Outcomes:

1. Students will understand the basics of an ECG
2. Students will gain knowledge on EEG signal and EEG machine.
3. Students will know the mechanics behind muscle contraction and relaxation
4. Students would be able to fully understand the working of audiometer and the GSR

TEXT BOOKS

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson education, 2003.
2. John G.Webster, Medical Instrumentation Application and Design, third edition,Wiley India Edition, 2007.

REFERENCE BOOKS

1. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw Hill, 2003.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation".
4. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Students will understand the basics of an ECG	3		2		3	1							3	2	1
CO2	Students will gain knowledge on EEG signal and EEG machine.	3		2		3	2							3	2	1
CO3	Students will know the mechanics behind muscle contraction and relaxation	3		2		3	2							3	2	1
CO4	Students would be able to fully understand the working of audiometer and the GSR	2		2		3	2							3	2	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BMT02	THERAPEUTIC EQUIPMENT	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Biomedical Instrumentation**

Course Objectives:

1. To learn and understand the principle of diathermy and its types.
2. To learn various cardiac therapeutic equipments
3. To study the functioning of muscle and nerve stimulators.
4. To study the various extra-corporeal devices
5. 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. High frequency therapy - Short wave diathermy, ultrasonic diathermy, Microwave diathermy

UNIT II CARDIAC EQUIPMENT **9**

Cardiac Pacemaker- Internal and External Pacemaker–Batteries, AC and DC Defibrillator-Internal and External ,Infusion pump

UNIT III PHYSIOTHERAPY AND ELECTROTHERAPY EQUIPMENTS **9**

Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level. Pain relief through electrical stimulation – TENS, FES.IR and UV lamp and its application.

UNIT IV EXTRA CORPOREAL DEVICES **9**

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenerators, finger pump, roller pump, Haemo Dialyser unit, Lithotripsy, Laparoscopy.

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 – Electrical safety codes and standards – Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

TOTAL: 45 PERIODS

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Course Outcomes:

1. Student will identify the types and uses of diathermy units.
2. Will know about defibrillator and pacemaker devices
3. Student would be able to understand the working of physiotherapy and electrotherapy equipments
4. Student would be able to fully understand the working of extra-corporeal devices like Heart-lung machine, oxygenator.
5. Student will gain knowledge on patient's electrical environment and electrical safety codes

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", John Willey and sons, 2002

3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", John Willey and sons, New York, 1997

REFERENCE BOOKS

1. Principles of Biomedical Instrumentation and Measurement" – Richard Aston, Merril Publishing Company, 1990.

2. Principles of Applied Biomedical Instrumentation L.A Geddas and L.E.Baker – 2004.

3. John G. Webster, Bioinstrumentation", John Willey and sons, New York, 2004.

4. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw- Hill, New Delhi, 2003.

5. Standard Handbook of Biomedical Engineering & Design – Myer Kutz McGraw-Hill Publisher, 2003.

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Student will identify the types and uses of diathermy units.	3		2	2		3							3	2	1
CO2	Will know about defibrillator and pacemaker devices	3		2	2		3							3	2	1
CO3	Student would be able to understand the working of physiotherapy and electrotherapy equipment's	3		3	2		3							3	2	1
CO4	Student would be able to fully understand the working of extra-corporeal devices like Heart-lung machine, oxygenator.	3		3	3		3							3	2	1
CO5	Student will gain knowledge on patient's electrical environment and electrical safety codes	3		3			3							3	2	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BMT03	RADIOLOGICAL EQUIPMENTS	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Nil**

Course Objectives:

1. To get the clear understanding of X-ray generation and radio isotopes and various
2. To study the functioning of X-ray tubes and scattered radiation and methods by which
3. To study the different types radio diagnostic unit.
4. To know the techniques to visualize opaque, transparent organs.
5. To study the special techniques adopted to visualize different sections of any organ.

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, X-Ray Image intensifier tubes - Fluoroscopy – Digital Fluoroscopy. Angiography, Cine angiography. Digital Subtraction Angiography, Mammography.

UNIT II COMPUTER TOMOGRAPHY **9**

Principles of Tomography - First to Fourth generation scanners – Image reconstruction technique-Back projection and Iterative method. Spiral CT Scanning - Ultra fast CT Scanners- X-Ray Sources – Collimation – X-Ray Detectors – Viewing System.

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.

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.

UNIT V RADIATION THERAPY AND RADIATION SAFETY **9**

Radiation therapy-Linear accelerator, betatron, cesium and cobalt .Radiation Protection in Medicine –Radiation Protection principles, Radiation measuring instruments- Dosimeter, film Badges, Thermo luminescent dosimeters – Electronic dosimeter- ICRP regulation Practical reduction of dose to staff and visitors.

TOTAL: 45 PERIODS

Course Outcomes:

1. Will have an in depth idea about radiological equipments, their imaging techniques, appreciate their usage in the radiology department of hospital

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2. Will be gaining an adequate knowledge about the fundamentals of x-ray imaging and the radiation safety methods to be employed
3. Will know the different types of imaging and their usage
4. Will gain adequate knowledge about CT,MRI , gamma camera etc and to understand their application

TEXT BOOKS

1. Steve webb, Physics of Medical Imaging, , Taylor and Francis, 1988.
2. R. Hendee and Russell Ritenour "Medical Imaging Physics"–William, Wiley, Fourth Edition 2002

REFERENCE BOOKS

1. Physics and Radiobiology of Nuclear Medicine –Third edition – Gopal B.Saha –Publisher – Springer, 2006.
2. Medical Physics and Biomedical Engineering –B.H Brown , PV Lawford, R H Small wood , D R Hose , D C Barber , CRC Press, 1999.
3. Standard handbook of Biomedical Engineering and Design – Myer Kutz Publisher – McGraw – Hill, 2003.
4. P.Raghunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine" Concepts and Techniques, Orient Longman, 2007.

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Will have an in depth idea about radiological equipments, their imaging techniques, appreciate their usage in the radiology department of hospital	1	3	3	2		1							2	3	1
CO2	Will be gaining an adequate knowledge about the fundamentals of x-ray imaging and the radiation safety methods to be employed	1	3	3	2		1							2	3	1
CO3	Will know the different types of imaging and their usage	1	3	3	2		1							2	2	1
CO4	Will gain adequate knowledge about CT,MRI , gamma camera etc and to understand their application	1	3	3	2		1							2	3	1
CO5	Will have an in depth idea about radiological equipments, their imaging techniques, appreciate their usage in the radiology department of hospital	1	2	3	2		1							1	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BMT04	MEDICAL EMBEDDED SYSTEMS	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Microprocessor & Microcontroller**

Course Objectives:

1. Learn the architecture and programming of ARM processor.
2. Be familiar with the embedded computing platform design and analysis.
3. Be exposed to the basic concepts of real time Operating system.
4. Learn the system design techniques and networks for embedded systems

UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and microprocessors– Embedded system design process – Formalism for system design– Design example: Model train controller- ARM Processor Fundamentals- Instruction Set and Programming using ARM Processor.

UNIT II COMPUTING PLATFORM **9**

CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor– Memory system mechanism – CPU performance – CPU power consumption- CPU buses – Memory devices – I/O devices – Component interfacing- System Level Performance Analysis- Parallelism. Design Example : Data Compressor.

UNIT III PROGRAM DESIGN AND ANALYSIS **9**

Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Program Optimization- Analysis and optimization of execution time, power, energy, program size – Program validation and testing- Example : Software Modem.

UNIT IV PROCESS AND OPERATING SYSTEMS **9**

Multiple tasks and Multi processes – Processes – Context Switching – Operating Systems – Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.

UNIT V HARDWARE ACCELERATORS & NETWORKS **9**

Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded Architecture – Networks for Embedded Systems: - I2C, CAN Bus, SHARC link supports, Ethernet, Myrinet – Network based design – Internet enabled systems. Design Example: Digital Still Camera – Video Accelerator.

TOTAL: 45 PERIODS

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Course Outcomes:

1. Describe the architecture and programming of ARM processor.
2. Outline the concepts of embedded systems
3. Explain the basic concepts of real time Operating system design.
4. Use the system design techniques to develop software for embedded systems.

TEXT BOOKS:

1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint from Elsevier), Second Edition, 2008.
2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide- Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008.

REFERENCES:

1. David E-Simon, "An Embedded Software Primer", Pearson Education, 2007.
2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press, 2005.
3. Jane.W.S. Liu, "Real-Time systems", Pearson Education Asia.
4. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-Graw Hill, 2004.
5. Tammy Noergaard, "Embedded Systems Architecture", Elsevier,2006.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Describe the architecture and programming of ARM processor.	3		3		3								1	3	2
CO2	Outline the concepts of embedded systems	3		3		3								1	3	2
CO3	Explain the basic concepts of real time Operating system design.	3		3		3								1	3	2
CO4	Use the system design techniques to develop software for embedded systems.	3		3		3								1	3	2

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BMT05	BIOMATERIALS AND ARTIFICIAL ORGANS	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Nil**

Course Objectives:

1. To study the basics of biomaterials, mechanical properties, viscoelasticity, wound healing process and blood compatibility.
2. To study the characteristics and medical applications of metallic implants like stainless steel, co and Ti based materials
3. To understand the characteristics and medical applications of polymeric implants like polyamides, acrylic polymers, rubbers, thermoplastics & bio polymer materials.
4. To understand the different soft and hard tissue replacements, sutures, adhesives skin implants, blood interfacing implants.
5. To study the artificial instrumentation used like heart, valves, oxygenator (artificial lungs), Dialyzer (artificial kidneys), dental implants.

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

Definition and classification of bio-materials, mechanical properties, visco elasticity,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, adhesive, 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 (oxygenateor), Artificial Kidney (Dialyser membrane) , Dental Implants.

TOTAL : 45 PERIODS

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Course Outcomes:

1. Knowledge about the basics of biomaterials, mechanical properties, wound healing process and blood compatibility, properties , characteristics and applications of metallic implants
2. Knowledge about the properties, characteristics and applications of polymeric implants
3. Knowledge about the applications of soft and hard tissue replacements, skin implants and blood interfacing implants
4. Gain knowledge on the artificial instrumentation used like heart, valves, oxygenator (artificial lungs), Dialyzer (artificial kidneys), dental implants.

TEXT BOOKS:

1. Sujata V. Bhatt, Biomaterials Second Edition ,Narosa Publishing House,2005.
2. Biomaterials - Principles and Applications – JoonB.Park Joseph D.Bronzino, CRC Press, 2003

REFERENCE BOOKS:

1. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.
2. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill, 2003
3. Introduction to Biomedical Engineering – John Enderle, Joseph D. Bronzino,Susan M. Blanchard, Elsevier, 2005.

	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Knowledge about the basics of biomaterials, mechanical properties, wound healing process and blood compatibility, properties , characteristics and applications of metallic implants	3	2	2			1							2	3	1
CO2	Knowledge about the properties, characteristics and applications of polymeric implants	3	2	2			1							2	3	1
CO3	Knowledge about the applications of soft and hard tissue replacements, skin implants and blood interfacing implants	3	2	2			1							2	3	1
CO4	Gain knowledge on the artificial instrumentation used like heart, valves, oxygenator (artificial lungs), Dialyzer (artificial kidneys), dental implants.	3	1	2			1							2	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BME06	MEDICAL SAFETY AND QUALITY ASSURANCE	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Nil**

Course Objectives:

1. To understand how safety is important for health care systems.
2. To gain knowledge about shocks and leakage current.
3. To know about various measuring and monitoring techniques
4. To know about radiological equipment safety.
5. To know how to manage medical devices.

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 AND SAFETY **9**

Macroshock and microshock, Current, Voltage and conductance, Earth and protection classes, earth fault circuit breakers and isolation transformers, leakage currents, biological effects of electromagnetic fields, Susceptibility to water. Gas technology, Fire, Thermal injuries.

UNIT III MEASUREMENT TECHNIQUES **9**

Accuracy and Precision-measurement uncertainty- characteristics of measuring devices. Measurement methods and values – temperature, sound, pressure, blood flow, electrophysiology, intensive care monitoring, fetal monitoring.

UNIT IV 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, anaesthetic machines, oxygen treatment, treatment with Nitric oxide, pressure chamber treatment, Incubators and monitoring.

UNIT V RESPONSIBILITY **9**

Electrical safety codes and standards-Medical Devices, Quality management, risk management, types of responsibilities, delegating, procurement, status and other publications, overall responsibility.

TOTAL: 45 PERIODS

Course Outcomes:

1. Knowledge about safety devices necessary for health care system can be identified
2. Gain knowledge about how electricity, gas and fire leakage can be reduced
3. An understanding how accuracy and precision can be obtained by measuring techniques.
4. Gain knowledge about radiological equipment safety.

TEXT BOOK:

1. Bertil Jacobson and Alan Murray, "Medical Devices use and safety", Reed Elsevier India Pvt. Ltd, New Delhi, 2001.

REFERENCE BOOKS:

1. Steve Webb, "The Physics of Medical Imaging", Taylor & Francis, New York, 1988.
2. G.D.Kunder, S.Gopinath, A.Katakam, "Hospital Planning, Design and Management", Tata Mcgraw Hil publishers, New Delhi, 1998.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", John Willey and sons, New York, 1997.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Knowledge about safety devices necessary for health care system can be identified	1					2	1	2					1	2	3
CO2	Gain knowledge about how electricity, gas and fire leakage can be reduced	1					2	1	2					1	2	3
CO3	An understanding how accuracy and precision can be obtained by measuring techniques.	1					1	1	2					1	2	3
CO4	Gain knowledge about radiological equipment safety.	1					3	1	1					1	2	3
CO5	Knowledge about safety devices necessary for health care system can be identified	1					3	1	2					1	2	3

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615ECO09	VLSI DESIGN	3	0	0	3	50	50	100

COURSE OBJECTIVES:

- Understand the basic CMOS circuits.
- Learn the fabrication of the CMOS using several process.
- Know the concepts of designing VHDL.
- Design the inverter and logic gates using the CMOS technology.
- Learn the basic debugging process in digital circuits.

UNIT I MOS TECHNOLOGY 9

Chip Design Hierarchy- IC Layers –Photolithography and Pattern Transfers- Basic MOS Transistors-CMOS Fabrication – Submicron CMOS Process – Mask and Layout – CMOS Design Rules: Lambda based layout.

UNIT II MOS TRANSISTOR 9

NMOS and PMOS transistors, Threshold voltage - Body effect - Design equations - Second order effects. MOS models and small signal AC characteristics - CMOS-DC and transient characteristics.

UNIT III INVERTER AND LOGIC GATES 9

NAND and NOR Gates – Complex Logic Gates(AOI and OAI logic) –Tri state circuits – Large FETs-Transmission Gate and Pass Transistor Logic- NMOS and CMOS Inverters, Stick diagram, Inverter ratio, Driving large capacitance loads, Static CMOS design, dynamic CMOS design.

UNIT IV BASICS OF TESTING AND FAULT MODELING 9

Introduction to testing - Faults in Digital Circuits – Modeling of faults – Logical Fault Models – Fault detection – Fault Location – Fault dominance – Design for testability – Boundary scan.

UNIT V VHDL 9

VHDL Program Structure- concurrent code – sequential code - Variables- Signals and Constants-VHDL Operators -VHDL Description of Combinational Networks: Adders ,Subtractor– VHDL Model for Multiplexer- Modeling Flip Flop using VHDL Processes — Modeling a sequential Machine.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Discuss the different design hierarchy of the CMOS circuits.
CO2: Determine of the various characteristics of the MOS transistor.
CO3: Design the inverter and logic gates using the CMOS technology.
CO4: Perform the testing and fault modeling in any design.
CO5: Write Programs based on the VHDL structure

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TEXT BOOKS:

1. John P Uyemura- "Chip Design for Submicron VLSI:CMOS layout and simulation" Thomson India Edition- 2006.
2. Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Pearson Education ASIA, 2nd edition, 2000.
3.

REFERENCE BOOKS:

1. Eugene D.Fabricius, Introduction to VLSI Design McGraw Hill International Editions,1990
2. M.Abramovici, M.A.Breuer and A.D. Friedman, "Digital systems and Testable Design", Jaico Publishing House,2002.
3. Charles H Roth-"Digital System Design Using VHDL"- Thomson business Information India Pvt Ltd-2006 .
4. Kamran Eshraghian- Douglas A PucknellSholehEshraghian "Essentials of VLSI Circuits and Systems"- Prentice Hall of India Pvt Ltd- 2006 Wayne Wolf," Modern VLSI Design – System On Chip", PHI 2006, 3e, New Delhi.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Discuss the different design hierarchy of the CMOS circuits.	3	2	3	1	1	2					2	2	1	3	1
CO2	Determine of the various characteristics of the MOS transistor.	3	2	3	2	1	2					2	2	1	3	1
CO3	Design the inverter and logic gates using the CMOS technology.	3	2	3	2					1		2	2	2	3	1
CO4	Perform the testing and fault modeling in any design.	3	2	3	2					1		2	2	2	3	1
CO5	Write Programs based on the VHDL structure	3	2	3	2					1		2	2	2	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615BMP08	DIAGNOSTIC AND THERAPEUTIC LAB	0	0	4	2	50	50	100

Designation: Professional Core

Pre-requisites: Diagnostic and Therapeutic Equipments I

Course Objectives:

1. To study various display techniques and use of ultrasonics in various fields of medicine
2. To understand various patient monitoring systems and transmission of biosignals using telemetry principles
3. To study the clinical applications of diathermy, its principle and types.
4. To study some of extra-corporeal devices and few of the diagnostic techniques.
5. To study the sources of leakage current and method of monitoring it.

LIST OF EXPERIMENTS:

1) Study of ultrasonic transducers and displays.
2) Study of pacemaker.
3) Biotelemetry.
4) Shortwave and ultrasonic diathermy.
5) Multichannel data acquisition system.
6) Simulation of biosignals.
7) Analysis of ECG signals.
8) Analysis of EEG signals.
9) Leakage current and electrical safety measurements.

Course Outcomes:

1. Students will understand the basic and principle of ultrasound.
2. Students will know about telemetry and the various bio-telemetric units
3. Student will identify the types and uses of diathermy units.
4. Student will know the tissue responses and about electro-surgical units

	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Students will understand the basic and principle of ultrasound.	3		2	2	3								3	3	2
CO2	Students will know about telemetry and the various bio-telemetric units	3		2	2	3								3	3	2
CO3	Student will identify the types and uses of diathermy units.	3		2	2	3								3	3	2
CO4	Student will know the tissue responses and about electro-surgical units	3		2	2	3								3	3	2

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Course Code	Course Name	L	T	P	C	CA	EA	Total
615BMP09	EMPLOYABILITY SKILLS LAB	0	0	4	2	50	50	100

Pre – Requisite: Technical English - I & Technical English - II

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 (P:30): 30 PERIODS

COURSE OUTCOMES:

1. Enhancing the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
2. Improving their soft skills, including report writing, necessary for the workplace situations
3. Creating effective PPTs and presenting the visuals effectively
4. 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

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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.
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	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	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
CO5	Enhancing the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills					1			2		3	2				

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMT01	MEDICAL OPTICS	3	0	0	3	50	50	100

Designation: Professional Core

Pre-requisites: Fundamental knowledge in Medical Physics is needed

Course Objectives:

1. To get the clear understanding of the principle of light and its applications in the field of medicine.
2. To get an in depth knowledge about the optical properties of the tissues.
3. To study about the different types of lasers used in therapy.
4. To know the techniques to visualize opaque, transparent organs.
5. To gain knowledge about optical coherence tomography unit and its applications.

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 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.

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 SPECIAL OPTICAL TECHNIQUES 9

Near field optical microscopy, Fluorescence Resonance Energy Transfer (FET) imaging,

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Fluorescence Lifetime Imaging Microscopy(FLIM), Photodynamic therapy (PDT)-Basic principles, Mechanism of photodynamic action, Light irradiation for PDT, Application of PDT,

TOTAL: 45 PERIODS

Course Outcomes:

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

1. Get the clear understanding of the principle of light and its applications in the field of medicine.
2. Get an in depth knowledge about the optical properties of the tissues.
3. Study about the different types of lasers used in therapy.
4. Know the techniques to visualize opaque, transparent organs.
5. Gain knowledge about optical coherence tomography unit and its applications.

TEXT BOOKS:

1. Tuan Vo Dinh, "Biomedical photonics – Handbook", CRC Press, 2014 (Unit I,II,IV,V)
2. Abraham Katzir "Laser and optical fibers in Medicine", Academics Press,2012 (Unit-III)
3. Mark E. Brezinski., Optical Coherence Tomography: Principles and Applications,Academic Press, 2006 (Unit-IV)

REFERENCE BOOKS:

1. Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and Sons, Inc. Publications, 2003 (Unit-V)
2. Anders Brahme ,"Comprehensive biomedical physics",Elsevier,2014
3. Leon Goldman, M.D., & R. James Rockwell, Jr., "Lasers in Medicine", Gordon and Breach, Science Publishers Inc., New York, 1971.
4. David H Shiney .Stephen and L Trokel , "Medical Lasers and their safe use",Springer publications.
5. R. Splinter and B.A Hooper, "An Introduction to Biomedical Optics", Taylor and Francis,2007

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Get the clear understanding of the principle of light and its applications in the field of medicine.	3		2										2	3	1
CO2	Get an in depth knowledge about the optical properties of the tissues.	3		2										2	3	1
CO3	Study about the different types of lasers used in therapy.	3		2										2	3	1
CO4	Know the techniques to visualize opaque, transparent organs.	3		2										2	3	1
CO5	Gain knowledge about optical coherence tomography unit and its applications.	3		2										2	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMT02	DIGITAL IMAGE PROCESSING	3	0	0	3	50	50	100

Designation: Professional Core

Pre-requisites: Fundamental knowledge in Digital Signal Processing is needed

Course Objectives:

1. To learn digital image fundamentals.
2. To understand the concept in image enhancement techniques
3. To study the image restoration and recognition
4. To be familiar with segmentation techniques.
5. To learn image compression techniques.

UNIT I DIGITAL IMAGE FUNDAMENTAL AND TRANSFORMS **9**

Elements of digital image processing systems, Vidicon and 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, KLT, SVD and their properties.

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 RESTORATION AND RECOGNITION **9**

Image degradation models – unconstrained and constrained restoration – inverse filtering – LMS filter – geometric mean filter – geometric transformation – pattern classes – optimal statistical classifier – neural networks and its uses in image processing.

UNIT IV 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 V IMAGE COMPRESSION **9**

Image compression models – elements of information theory – error free compression –lossy compression – run-length – Huffman coding – shift codes – arithmetic coding – bit plane coding

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– transform coding – JPEG standards – MPEG standards – wavelet transform – predictive techniques – block truncation coding schemes, Vector quantization.

TOTAL: 45 PERIODS

Course Outcomes:

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

1. Learn digital image fundamentals.
2. Understand the concept in image enhancement techniques
3. Study the image restoration and recognition
4. Be familiar with segmentation techniques
5. Learn image compression techniques

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

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Learn digital image fundamentals.	3	2		3	3									3	1
CO2	Understand the concept in image enhancement techniques	3	2		3	3									3	1
CO3	Study the image restoration and recognition	3	2		3	3									3	1
CO4	Be familiar with segmentation techniques	3	2		3	3									3	1
CO5	Learn image compression techniques	3	2		3	3									3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMT03	BIOMECHANICS	3	0	0	3	50	50	100

Designation: Professional Core

Pre-requisites: Fundamental knowledge in Medical Physics is needed

Course Objectives:

1. To understand the principles of mechanics that is used to analyse human movement.
2. To study about the fluid mechanic system applied to human body
3. To study the structure and functions of skeletal muscle
4. To study the structure, movements, and loads applied to knee, shoulder and hip.
5. To study about 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 – 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 – Laminar flow and turbulent flow-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.

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

TOTAL: 45 PERIODS

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Course Outcomes:

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

1. Understand the principles of mechanics that is used to analyse human movement.
2. Study about the fluid mechanic system applied to human body
3. Study the structure and functions of skeletal muscle
4. Study the structure, movements, and loads applied to knee, shoulder and hip.
5. Study about the bone structure, joints and cartilage

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)
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)

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.

	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the principles of mechanics that is used to analyse human movement.	3	2	3										2	3	1
CO2	Study about the fluid mechanic system applied to human body	3	2	3										2	3	1
CO3	Study the structure and functions of skeletal muscle	3		3										2	3	1
CO4	Study the structure, movements, and loads applied to knee, shoulder and hip.	2		3										2	3	1
CO5	Study about the bone structure, joints and cartilage	3		3										2	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMT04	PATTERN RECOGNITION AND NEURAL NETWORKS	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Nil**

Course Objectives:

1. To understand the fundamentals of pattern recognition and its application.
2. To analyze the supervised and unsupervised algorithms suitable for pattern Classification.
3. To provide the fundamentals of Neural networks
4. Design and apply back propagation network and neural networks based on competition
5. To offer the knowledge in Fuzzy Logic and Genetic algorithms

UNIT I INTRODUCTION AND SUPERVISED LEARNING **9**

Overview of Pattern recognition, Types of Pattern recognition, Application of pattern recognition. Parametric and Nonparametric approach- Bayesian classifier-Discriminant function. Non parametric density estimation- histograms- kernels- window estimators- k- nearest neighbor classifier- estimation of error rates.

UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS **9**

Unsupervised learning- Hierarchical clustering- Single-linkage Algorithm- Complete –linkage Algorithm- Average-linkage algorithm-Ward's method. Partitional clustering- Forgy's Algorithm- k-means algorithm -Isodata Algorithm.

UNIT III: INTRODUCTION AND SIMPLE NEURAL NET **9**

Elementary neurophysiology and biological neural network-Artificial neural network – Architecture- biases and thresholds-Hebb net- Perceptron, SVM, Adaline- LMS learning algorithm rule-Application. Madaline- MRII Training Algorithm-Translation invariant pattern recognition

UNIT IV: BACK PROPOGATION, ASSOCIATIVE MEMORY AND NEURAL NETWORKS BASED ON COMPETITION **9**

Back Propogation Network, generalized delta rule, Bidirectional Associative Memory, Hopefield network. Kohonen Self Organizing Map, Learning Vector Quantization, Counter Propogation Network.

UNIT V: FUZZY LOGIC AND GENETIC ALGORITHM **9**

Fuzzy Logic – Introduction, Fuzzy classification using Mamdani and Sugeno model, Fuzzy clustering – application in image segmentation. Introduction to Genetic Algorithm – Roulette wheel selection.

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TOTAL: 45 PERIODS

Course Outcomes:

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

1. Understand the fundamentals of pattern recognition and its application.
2. Analyze the supervised and unsupervised algorithms suitable for pattern Classification.
3. Provide the fundamentals of Neural networks
4. Design and apply back propagation network and neural networks based on competition
5. Offer the knowledge in Fuzzy Logic and Genetic algorithms

TEXT BOOKS:

1. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 2016.
3. Freeman J.A., and Skapura B.M, " Neural networks, algorithms, applications and programming techniques", Addison – Wesley, 2014

REFERENCE BOOKS:

1. Robert Schalkoff, " Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons(Asia) Pte. Ltd., Singapore, 2005
2. LaureneFausett ," Fundamentals of neural networks – Architectures, algorithms and applications", Prentice Hall, 1994.
3. Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt. Ltd., New Delhi , 2002
4. Duda R.O, Hart P.G, "Pattern classification and scene analysis", Wiley Edition,2000
5. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Understand the fundamentals of pattern recognition and its application.	3	2		3	2									3	2
CO2	Analyze the supervised and unsupervised algorithms suitable for pattern Classification.	3	2		3	2									3	2
CO3	Provide the fundamentals of Neural networks	3	2		3	2									3	2
CO4	Design and apply back propagation network and neural networks based on competition	3	2		3	2									3	2
CO5	Offer the knowledge in Fuzzy Logic and Genetic algorithms	3	2		3	2									3	2

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMT05	MEDICAL INFORMATICS	3	0	0	3	50	50	100

Designation: Professional Core **Pre-requisites: Nil**

Course Objectives:

1. To appreciate the role of Informatics in engineering and medicine.
2. To understand the importance of Medicine and the Internet
3. To analyze the concept in Medical Imaging and Clinical Laboratory
4. To understand the importance of Tele medicine and Hand Held Computers
5. 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

UNIT III COMPUTER ASSISTED MEDICAL IMAGING AND CLINICAL LABORATORY 9

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

UNIT IV TELEMEDICINE AND TECHNOLOGY 9

Telemedicine and internet, Medical Peripheral devices, Applications of telemedicine, Satellite Based Tele medicine. Hand-Held Computers-Palm Top Personal Digital Assistant (PDA), Medical applications

UNIT V COMPUTER AIDS 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

TOTAL: 45 PERIODS

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Course Outcomes:

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

1. Appreciate the role of Informatics in engineering and medicine.
2. Understand the importance of Medicine and the Internet
3. Analyze the concept in Medical Imaging and Clinical Laboratory
4. Understand the importance of Tele medicine and Hand Held Computers
5. Understand the importance of Computer Aids For the physically challenged

TEXT BOOK:

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

REFERENCE BOOKS:

1. Mohan Bansal, "Medicl informatics", Tata Mcgraw Hill Publishing computers Ltd, 2003 New Delhi.
2. N.Mathivanan, "PC-Based Instrumentation", Prentice Hall of India Pvt Ltd – New Delhi – 2007.
3. Orpita Bosu and Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press, 2007, New Delhi.
4. Yi – Ping Phoebe Chen, "Bioinformatics Technolgies", Springer International Edition, 2007, New Delhi

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Appreciate the role of Informatics in engineering and medicine.	3					2		2						2	1
CO2	Understand the importance of Medicine and the Internet	3					2		2						2	1
CO3	Analyze the concept in Medical Imaging and Clinical Laboratory	3					2		2						2	1
CO4	Understand the importance of Tele medicine and Hand Held Computers	3					2		2						2	1
CO5	Understand the importance of Computer Aids For the Handicapped	3					2		2						2	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BME06	REHABILITATION ENGINEERING	3	0	0	3	50	50	100

Designation: Professional Elective

Pre-requisites: Fundamental knowledge in Therapeutic Equipment is needed

Course Objectives:

1. To understand the concept of Rehabilitation & Rehabilitation team role of physiatrist
2. To get knowledge about Orthotic devices in Rehabilitation Engineering
3. To gain knowledge about Therapeutic exercise technique.
4. To know the Principle in Management of communication.
5. To know about level of amputation & Prosthetic device

UNIT I INTRODUCTION TO REHABILITATION & REHABILITATION TEAM 9

Introduction to Rehabilitation, Medical rehabilitation- Importance of Physiatry, Epidemiology of Rehabilitation, Health, Preventive Rehabilitation-Levels of prevention ,Impairment, disability & handicap-Diagnosis of disability, Functional diagnosis, Primary & secondary Disabilities, Rehabilitation team- Classification of members, Physical therapist, Occupational therapist, Prosthetist - Orthotist, Rehabilitation nurse, Speech pathologist, Psychologist & Child development specialist, Music therapist , Play therapist, Recreational therapist, Biomedical engineer ,Social worker, Vocational Counsellor

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 PRINCIPLES IN MANAGEMENT OF COMMUNICATION 9

Introduction to communication, Speech, Aphasia, Types of aphasia, Dysarthria, Speech therapy, Augmentative communication-general form of communication, types of visual aids, Writing aids.

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-Introduction, Classification of prosthesis, Components of prosthesis, Upper limb prosthetics-

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Plastic laminate socket, Terminal devices, above elbow prosthesis, below elbow prosthesis, Prosthesis for lower extremity

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Understand the concept of Rehabilitation & Rehabilitation team role of physiatrist
2. Get knowledge about Orthotic devices in Rehabilitation Engineering
3. Gain knowledge about Therapeutic exercise technique.
4. Know the Principle in Management of communication.
5. Know about level of amputation & Prosthetic device

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	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 concept of Rehabilitation & Rehabilitation team role of physiatrist	3		2			3							3	2	1
CO2	Get knowledge about Orthotic devices in Rehabilitation Engineering	3		2			3							3	2	1
CO3	Gain knowledge about Therapeutic exercise technique.	3		2			3							3	2	1
CO4	Know the Principle in Management of communication.	3					3							3	2	1
CO5	Know about level of amputation & Prosthetic device	3		2			3							3	2	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BME07	PROFESSIONAL ETHICS AND HUMAN VALUES	3	0	0	3	50	50	100

Designation: Professional Elective **Pre-requisites: Nil**

Course Objectives:

1. To enable the students to create an awareness on Engineering Ethics and Human Values.
2. To instill Moral and Social Values and Loyalty and to appreciate the rights of others.
3. To understand the Global Issues in various Professional Bodies.

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:45 PERIODS

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Course Outcomes:

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

1. Apply ethics in society.
2. Discuss the ethical issues related to engineering.
3. Realize the responsibilities and rights in the society.

TEXTBOOK

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York, 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES

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.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Apply ethics in society	1		1			2	2	3							3
CO2	Discuss the ethical issues related to engineering	1		1			2	2	3							3
CO3	Realize the responsibilities and rights in the society	1		1			2	2	3							3

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMP07	DIGITAL IMAGE PROCESSING LAB	0	0	4	2	50	50	100

Designation: Professional Core

Pre-requisites: Fundamental knowledge in Digital Signal Processing Lab is needed

Course Objectives:

1. To practice the basic image processing techniques.
2. To understand the functions of transforms.
3. To know the effect of quantization.
4. 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:

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

1. Perform filtering operations in the image
2. Use transforms and analyzes the characteristics of the image.
3. Analyze the texture of the image
4. Implement project on simple image processing applications.

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
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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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMP08	HOSPITAL TRAINING LAB	0	0	2	1	50	50	100

Category : Employability Enhancement Course

Pre-requisites: Fundamental knowledge in Professional Core subject is needed

COURSE OBJECTIVES:

The student should be made to

1. Observe medical professionals at work in the wards and the roles of Allied Health Professionals.
2. Provide access to healthcare Professionals to get a better understanding of their work.
3. 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.

COUSE OUTCOMES:

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

1. Advocate a patient-centred approach in healthcare
2. Communicate with other health professionals in a respectful and responsible manner
3. Recognize the importance of inter-professional collaboration in healthcare.
4. Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs
5. Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

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	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Enable the students to gain practical knowledge about instruments used in hospitals for diagnostic and therapeutic applications	3					3		2	2	2	1	1	2	2	3
CO2	Will able to gain experience in handling the equipments and learn to correct the errors in the instruments in hospitals	3					3		2	2	2	1	1	2	2	3

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715BMP09	MINI PROJECT	0	0	4	2	50	50	100

Designation: Professional Core

Pre-requisites: Fundamental knowledge in Engineering Practice Lab is needed

Course Objectives:

1. 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.
2. 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: 45 PERIODS

Course Outcomes:

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

1. Culminate in gaining of major design experience in the related area of specialization.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	The student will 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 Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815BMT01	HOSPITAL ENGINEERING AND MANAGEMENT	3	0	0	3	50	50	100

Subject Description: Professional Core

Pre-requisites: Fundamental Knowledge in Diagnostic Equipment & Therapeutic Equipment are needed

COURSE OBJECTIVES:

1. To understand the fundamentals of hospital administration and management
2. To learn the concept of human resource management in hospital
3. To know the market related research process
4. To explore various information management systems and relative supportive services
5. 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 - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste 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.

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: 45 PERIODS

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COURSES OUTCOMES:

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

1. Understood the concepts of hospital administration and biomedical waste management
2. learnt the concept of leadership grooming and training in hospital
3. Known the marketing information system
4. Explored various clinical and management information systems
5. Learnt the medical standards in hospitals

TEXT BOOKS:

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI, Fourth Edition, 2006.
2. G.D.Kunders, "Hospitals -Facilities Planning and Management" TMH, New Delhi, Fifth Reprint 2007.

REFERENCES:

1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, New York, 1977.
2. Norman Metzger, "Handbook of Health Care Human Resources Management", 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman, "Health Sector Reform in Developing Countries", Harvard University Press, 1995.
4. William A. Reinke, "Health Planning For Effective Management" ,Oxford University Press.1988
5. Blane, David, Brunner, "Health and SOCIAL Organization Towards a Health Policy for the 21st Century", Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", 6th Edition Cengage Learning, 2011.
7. http://www.nabh.co

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Understood the concepts of hospital administration and biomedical waste management	1					3		2	2	2	1			2	3
CO2	learnt the concept of leadership grooming and training in hospital	1					3		2	2	2	1			2	3
CO3	Known the marketing information system	1					2			2	2	1			2	3
CO4	Explored various clinical and management information systems						2		2	3	2	1			2	3
CO5	Learnt the medical standards in hospitals						2		3	2	1	1			2	3

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815BME04	ASSIST DEVICES	3	0	0	3	50	50	100

Subject Description: Professional Elective

Pre-requisites: Fundamental Knowledge in Diagnostic Equipment & Therapeutic Equipment is needed

COURSE OBJECTIVES:

1. To study various cardiac assist devices
2. To learn the functioning of Hemodialysers
3. To understand the principles of hearing aids
4. To know the various orthotic devices and prosthetic devices to overcome orthopedic problems.
5. To understand 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.

UNIT II HEMODIALYSERS **9**

Artificial kidney, Dialysis action, Hemodialysis unit, membrane dialysis, portable dialyser monitoring and functional parameters, 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, Face Orthotics, Dental Implants, Bowel and hip replacement techniques.

UNIT V RECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, Bio-feedback - EMG, EEG, Electrodermal, Cardiorespiratory biofeedback ,Applications of biofeedback.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Learnt various mechanical techniques that will help failing heart.
2. Understood the functioning of the unit which does the clearance of urea from the blood
3. Understood the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
4. Learnt the concept of hand and arm replacement
5. Understood principles of transcutaneous electrical nerve stimulators

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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.

REFERENCE:

1. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.

	Course Outcomes	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Learnt various mechanical techniques that will help failing heart.	3		3										2	3	1
CO2	Understood the functioning of the unit which does the clearance of urea from the blood	3		3										2	3	1
CO3	Understood the tests to assess the hearing loss and development of electronic devices to compensate for the loss	3		3										2	3	1
CO4	Learnt the concept of hand and arm replacement	3		3										2	3	1
CO5	Understood principles of transcutaneous electrical nerve stimulators	3												2	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815BME07	ADVANCED MEDICAL INSTRUMENTATION	3	0	0	3	50	50	100

Subject Description: Professional Elective

Pre-requisites: Fundamental Knowledge in Biomedical Instrumentation is needed

COURSE OBJECTIVES:

1. To know about working function of implantable stimulators.
2. To learn about sensory instruments.
3. To gain knowledge about various special equipments.
4. To gain knowledge about different analytical instruments.
5. 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 EQUIPMENTS **9**

Impedance techniques: Bipolar and retrapolar circuits, detection of physiological activities using impedance 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 EQUIPMENTS **9**

Brain–Computer interface, Pervasive Medical Care – Sports, Space, Military applications, Body Area Network. Smart phone based ECG monitoring system, Cloud computing technology- ECG, EEG and SpO_2

TOTAL: 45 PERIODS

COURSES OUTCOMES:

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

1. Known about neuromuscular stimulator and spine fusion stimulator.
2. Learnt about the concept of evoked potential response.
3. Gained knowledge about impedance technique
4. Gained knowledge about biochemical analysis system
5. Gained knowledge about cloud computing technology in medical application

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TEXT BOOKS

1. John G. Webster, "Medical Instrumentation Application and Design", Fourth Edition, John Wiley and Sons, Hoboken, NJ, 2009.
2. J. D. Bronzino, "The Biomedical Engineering Handbook- Vol. 1 & 2", Third Edition, CRC Press, 2006
3. R.S. Kandhpur, "Handbook of Analytical Instrumentation", Second Edition, Tata McGraw Hill, New Delhi, 2006.

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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", First Edition, Prentice Hall, 1987
3. John D. Enderle, "Susan M. Blanchard, Introduction to Biomedical Engineering", Academic Press, 1999.
4. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata subramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.

	Course Outcomes	PO 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O10	P O11	P O12	PS O1	PS O2	PS O3
CO1	Known about neuromuscular stimulator and spine fusion stimulator.	3					1							2	3	1
CO2	Learnt about the concept of evoked potential response.	3		3			1							2	3	1
CO3	Gained knowledge about impedance technique	3		3			1							2	3	1
CO4	Gained knowledge about biochemical analysis system	3		2			1							2	3	1
CO5	Gained knowledge about cloud computing technology in medical application	3		1			1							2	3	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815BMP04	PROJECT WORK	0	0	14	8	50	50	100

Subject Description: Professional Elective

Pre-requisites: Fundamental Knowledge in professional core subject is needed

Course Objectives:

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
2. 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: 210 PERIODS

COURSES OUTCOMES:

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

1. 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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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