Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115PHT03	ENGINEERING PHYSICS	3	0	0	3	50	50	100

Course objectives:
1. To understand the concept of properties of matter.
2. To understand the properties of sound and principles of quantization of energy.
3. To understand the properties of coherent light and its importance.

Unit-1 Properties of Matter 9

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

Unit-2 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 – SONAR – Non Destructive Testing – pulse echo system

Unit-3 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 – Theory and experimental verification – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box – Electrons in a metal.

Unit-4 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-5 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.

Total Hours: 45

Course Outcomes:
At the end of the course, the student will be able to
1. To understand properties of solids with different types of moduli and to gain knowledge about absorption coefficients of solids and different surfaces.

2. To understand basic concepts of high frequency sound waves and its applications.
3. To understand basic concepts of quantum mechanical behaviour of wave and particle

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along with applications.
4. To understand the concepts of production of laser and its behaviour with diffraction principle of interference.
5. 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).

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	To understand properties of solids with different types of moduli and to gain knowledge about 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 behaviour of wave and particle along with applications.	2		1		2		2		1		1	2	1	2	2
CO4	To understand the concepts of production of laser and its behaviour 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 fiber optic communication.	2		1		2		2		1		1	2	1	2	2

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ENGINEERING	L	T	P	C	CA	EA	Total
115CYT04	CHEMISTRY	3	0	0	3	50	50	100

Course objectives:
- To understand and apply the concepts in electrochemistry and Energy storage devices
- To understand the chemistry of Corrosion
- To apply the basic concepts of thermodynamics for engineering stream
- To understand the basic concepts of phase equilibrium
- To understand the chemistry behind water technology

Unit-1 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 lithiumnano battery. Clean energy fuel cells - H_2-O_2 fuel cell.

Unit-2 Corrosion and its Control   9
Basic concepts - mechanism of chemical, electrochemical corrosion - Pilling Bedworth rule – Types of Electrochemical corrosion - galvanic corrosion - differential aeration corrosion – Measurement of corrosion (wt. loss method only) - factors influencing corrosion. Corrosion control: Cathodic protection - sacrificial anodic method and impressive cathode current method. Electroplating (Copper plating) and Electrolessplating (Nickel plating)

Unit-3 Chemical Thermodynamics   9
Terminologies- System, Surroundings-First law of thermodynamics-Internal energy and enthalpy of system-Second law of Thermodynamics-entropy of a system-entropy change for an ideal gas- entropy change accompanying change of phase-Gibbs Helmholtz equation-Clausius –clapeyron equation-applications-Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

Unit-4 Phase Equilibria   9
Gibbs phase rule-definition of terms involved- Thermal analysis-application of phase rule to one Component system-water system – Sulphur system. Reduced Phase rule-application of phase rule to two Component system- lead-silver system- KI-water system and Ferric Chloride water system.

Unit-5 Water Technology   9
Physical, Chemical & Biological characteristics -Hardness of water - estimation of hardness (EDTA method) - Dissolved oxygen –determination and significances, Alkalinity – determination and significances - disadvantages of using hard water in boilers- Internal conditioning - phosphate, calgon and carbonate conditioning methods – External treatment: Zeolite, ion exchange methods - desalination – reverse osmosis and electrodialysis - domestic water treatment.

Total Hours   45

Course Outcomes:

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

CO1:Understanding the concepts of electrochemistry and Energy storage devices

CO2:Understanding the chemistry of Corrosion

CO3:Applying the basic concepts of thermodynamics for engineering stream

CO4:Understanding the basic concepts of phase equilibrium

CO5:Developing the knowledge of chemistry behind water technology

Text Books

1. P.C. Jain and Monika Jain, Engineering Chemistry,16th Edition (2013),Dhanpat Rai and Sons, NewDelhi

2. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 3rd Edition (2011). PHI Learning PVT., LTD, New Delhi.

3. K. Sivakumar, Engineering Chemistry, (2015), Sahana Publishers, Coiambatore.

Reference Books

1. S. S. Dara, A Textbook of Engineering Chemistry, S. Chand & Co., Ltd. 1st Edition (2010), NewDelhi.

2. B. K. Sharma, Engineering Chemistry, 3rd edition (2014) Krishna Prakashan Media (P)Ltd., Meerut.

3. ArunBhal, B.S. Bhal, G. D. Tuli, Essentials of Physical Chemistry,2015, S. Chand & Co., Ltd. New Delhi.

4. P. W. Atkins & Julio de Paula, Atkins' Physical Chemistry, Oxford University Press York, 7thEdn, 2013.

5. ShashiChawla, A Text Book of Engineering Chemistry, 3rd Edition, DhanpatRai&New Delhi, 2012.

6. S. Vairam, P. Kalyani&Suba Ramesh, Engineering Chemistry, IstEdn, John Wiley &Sons, India, 2011.

7. Lee J.D., Concise Inorganic Chemistry, 7th Edn, Blackwel Science Publications Oxford, London, 2008.

	COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Understanding the concepts of electrochemistry and Energy storage devices		1	2	1		1		1	2	2		1		1	1
CO2	Understanding the chemistry of Corrosion		1	2	1		1		1	2	2		1		1	1
CO3	Applying the basic concepts of thermodynamics for engineering stream	2		1		2		2		1		1	2	1	2	2
CO4	Understanding the basic concepts of phase equilibrium	2		1		2		2		1		1	2	1	2	2
CO5	Developing the knowledge of chemistry behind water technology		1	2	1		1		1	2	2		1		1	1

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115FPT05/ 115ESE02	FUNDAMENTALS OF COMPUTING & C PROGRAMMING	3	0	0	3	50	50	100

Course objectives:
- To understand the basics of computer and problem solving methods.
- To familiarize the structured programming & fundamentals.
- To learn the various features of C programming language

Unit-1 Introduction 9
Introduction - Characteristics of Computers - Basic Computer organization- Number System – Computer Software – Types – Problem Solving Techniques - Program Control Structures- Programming Paradigms – Characteristics of Good Program - programming Language - Compiler, Interpreter, Linker, Loader - Internet Basics.

Unit-2 C Language Basics 9
Introduction to C Programming – Fundamentals – Structure of a C Program – Compilation and Linking Processes – Constants, Variables – Data Types – Expressions Using Operators In C – Managing Input and Output Operations – Decision Making and Branching – Looping Statements – Solving Simple Scientific and Statistical Problems.

Unit-3 Arrays and Strings 9
Arrays – Initialization – Declaration – One Dimensional and Two Dimensional Arrays - Strings- String Operations – String Arrays. Simple Programs - Sorting- Searching – Matrix Operations- Preprocessor Directives.

Unit-4 Functions, Storage Classes and Pointers 9
Functions: Definition of function – Declaration of function – Pass by value – Pass by reference – Recursion.
Storage classes – auto, static, extern, register- scope rules.
Pointers: Definition – Initialization – Pointers arithmetic – Pointers and arrays - Dynamic memory allocation - Example Problems.

Unit-5 Structures, Unions and Files 9
Structures and Unions: Introduction – Need for structure data type – Structure definition – Structure declaration – Structure within a structure - Union - Programs using Structures and Unions.
Files: Introduction – Using files in C - Working with text files.

Total Hours: 45

Course Outcomes: At the end of the course, the student will be able to
CO1: Acquire knowledge in computer problem solving techniques.
CO2: Formulate algorithm for simple problems.
CO3: Implement the programs in C using arrays and strings.
CO4: Develop programs using functions, structures and files.

Text Books

1. Ashok.N.Kamthane,- "Computer Programming" , Pearson Education, Second edition (India), 2012.
2. E.Balagurusamy, - "Computing fundamentals and C Programming" , Tata McGraw-Hill Publishing Company Limited, 2008.

Reference Books

1. Pradip Dey, Manas Ghoush, -"Programming in C", Oxford University Press, 2012.
2. Byron Gottfried, - "Programming with C", 2nd Edition, (Indian Adapted Edition), Publications, 2010.
3. Stephen G.Kochan, - "Programming in C", 4th Edition, Pearson Education India, 2015
4. Brian W.Kernighan and Dennis M.Ritchie, -"The C Programming Language", Pearso Education Inc., 2005.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Acquire knowledge in computer problem solving techniques.			3	2							3			2	1
CO2	Formulate algorithm for simple problems.			3	2	3						2			2	1
CO3	Implement the programs in C using arrays and strings.			3	2	3						3			2	1
CO4	Develop programs using functions, structures and files.					3						3			2	1

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	INTRODUCTION TO	L	T	P	C	CA	EA	Total
115ESE10	BIOMEDICAL ENGINEERING	3	0	0	3	50	50	100

Course objectives:
- To understand the role of Biomedical Engineers
- To know the fundamentals of diagnostic devices
- To know the principles of radiological equipments
- To know the fundamentals of therapeutic equipments
- To know about various type of analyzers

Unit-1 Introduction 9

History of Medical Devices - Stethoscopes, Microscopes, Role of Biomedical Engineering Technologists in Healthcare, Characteristics of Human Anatomy and Physiology-Electrical Signals and Conductivity.

Unit-2 Diagnostic Devices 9

Bioelectric Potentials, Thermometers, ECG Monitors and Machines Ambulatory ECG Recorders, Blood Pressure Monitors, Blood Glucose Monitors, Pulse oximeters, Respiration Monitors, EEG Monitors and Machines, Endoscopes, ophthalmoscopes, Fetal Monitor.

Unit-3 Imaging Devices 9

X-rays, Magnetic Resonance Imaging Scanners, Positron Emission Tomography, Computed Tomography, Diagnostic Ultrasound, Picture Archiving and Communication systems.

Unit-4 Therapeutic Devices 9

Defibrillators, Pacemakers, Artificial Heart, Ventilators, Humidifiers, Anesthetic Machines, Hemodialysis, Lithotriptors, Physiotherapy Equipments

Unit-5 Specialized Equipments 9

Auto Analyzers, Calorimeter, Chromatography, AESU Analyzers, Infusion Device Analyzers, Physiological Simulators, Ventilator Analyzers, Incubator Analyzers.

Total Hours 45

Course Outcomes:

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

CO1: Understand the role of Biomedical Engineers.
CO2: Know the fundamentals of diagnostic devices.
CO3: Know the principles of radiological equipments
CO4: Know about various type of analyzers

Text Books
1. Laurence J Street," Introduction to Biomedical Engineering Technology", CRC Press, London, 2008.
2. Daniel A Vallero, "Biomedical ethics for Engineers", Elsevier publication, USA, 2007.

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Reference 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 Wiley and sons, New York, 2007
3. Joseph J Carr, John M Brown, "Introduction to Biomedical Equipment Technology", John Wiley & Sons, New York, 2008.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the role of Biomedical Engineers.	3		3	2										1	2	2
CO2	Know the fundamentals of diagnostic devices.	3		3	2										2	1	1
CO3	Know the principles of radiological equipments	3		3	2	1									2	2	2
CO4	Know about various type of analyzers	3		3	2	1										1	1

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ENGINEERING PHYSICS	L	T	P	C	CA	EA	Total
115PHP07	LAB	0	0	4	2	50	50	100

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- Ultrasonic interferometer.
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.

Course Outcomes: At the end of the course, the student will be able to
CO1: Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.
CO2: Understanding the phenomenon of diffraction, dispersion and interference of light using optical component
CO3: Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid and measuring 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 Rigidity modulus 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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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	FUNDAMENTALS OF	L	T	P	C	CA	EA	Total
115ESP07	COMPUTING & C PROGRAMMING LAB	0	0	4	2	50	50	100

Prerequisite: Nil

COURSE OBJECTIVES:
- To enable the students to prepare the documents, presentation using office automation tools.
- To enable the students to write programs using C.

LIST OF EXPERIMENTS:

Word Processing   6

1. a) Preparation of Bio – Data with header and Footer options
   b) Preparation of News-Bulletin with formatting options
2. a) Business Letter using Mail Merge concept
   b) Typing Equations and inserting Symbols
3. Table creation with formula & protecting a word document

Spread Sheet   6

4. Mark-Sheet preparation using formula editor

5. Preparation of various charts (Bar, Pie, Line)

6. Import/Export of excel file & protection of Excel file

Presentation   6

7. Prepare a presentation in Power point showing the features of MS OFFICE and also set timings to view it.
8. Prepare a presentation for showing the types of computers with the following settings:
   a) Set different slide transitions

   b) Give header & footer for each slide

   c) Hiding and Showing the slides access

9. a) Prepare a presentation with a text, picture & graph expressing the introduction of new product.

   b) Prepare a presentation with a text and picture for various courses offered in our college with animation effect.

C-Programming   27

10. Generation of Fibonnacci series.
11. Finding factorial of given number.
12. Printing multiplication table using While statement.

13. Program to evaluate Sine series.
14. Creating menu option with Switch-Case.
15. Programs using Function (with , without arguments).
16. Program using Recursive functions.
17. Program using 1-D,2-D Arrays.
18. Program using String.
19. Program using Structure and Union concept.
20. Program with Pointers.
21. Program using File Handling functions.

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Efficiently apply MS-Word and MS-Excel for creating document & spreadsheets for various applications.

CO2: Design presentation using MS-PowerPoint with animation effects.

CO3: Write and compile programs using C- Language.

CO4: Develop programs in C for any computing problems.

List of Equipments and Software for a batch of 30 students

Hardware:

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

Printer – 3 No's.

Software:

OS: Windows / Linux.

Application Package - Office Suite.Turbo C.

	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	Efficiently apply MS-Word and MS-Excel for creating document & spreadsheets for various applications.					3									2	1
CO2	Design presentation using MS-PowerPoint with animation effects.					3									2	1
CO3	Write and compile programs using C- Language.	1				3									2	1
CO4	Develop programs in C for any computing problems.	1				3									2	1

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215PHT03	APPLIED PHYSICS	3	0	0	3	50	50	100

COURSE OBJECTIVES

1. To enable students to understand the structure of solids and properties.

2. To understand the concept of classical theory and quantum theory.

3. To get the better knowledge of semiconductor materials.

4. Properties of magnetic materials and superconductors.

5. Recent development in new engineering materials.

UNIT I CRYSTAL PHYSICS   9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC, HCP and diamond structure – NaCl, ZnS structures (qualitative).

UNIT II CONDUCTING MATERIALS   9

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals .

UNIT III SEMICONDUCTING MATERIALS   9

Intrinsic semiconductor – Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductor – Variation of Fermi level with temperature and impurity concentration – Electrical conductivity of extrinsic semiconductors.

UNIT IV DIELECTRIC MATERIALS AND NANO MATERIALS   9

Electrical susceptibility – Dielectric constant – Electronic, ionic, orientational and space charge polarization – Frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation).Nano materials: Synthesis – Plasma arcing – Chemical vapour deposition, Electro deposition – Ball milling – Properties of nanoparticles and applications.

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Nuclear fission-Nuclear fusion-Stellar energy-conditions to be satisfied for sustained nuclear reactions-nuclear reactors-classification-general features-efficiency-coolants moderations thermal reactors. Heat conduction-Expression for thermal conductivity- Amount of heat flow through a plane wall in one direction- Heat conduction through a compound media of two layers-Determine thermal conductivity-Lee's disc method for bad conductors-Heat conducting through spherical and cylindrical bodies.

Course Outcomes:

CO1: Analyzing and identifying the crystal structure and lattice parameters in solid materials.

CO2: Understanding the physical properties and concept of classical and quantum theories for electron behaviour in conducting materials.

CO3: Determining the carrier concentration and electrical conductivity of intrinsic and extrinsic semiconductors.

CO4: Understanding the various polarization mechanisms in dielectrics and the techniques to manufacture nano materials for engineering applications.

CO5: Acquiring the knowledge about nuclear physics in energy production and the phenomenon of thermal conductivity through different media of materials.

TEXT BOOKS:

1. Jayaprakash R.N, 'Engineering Physics - II', Dhanam Publications, Chennai, (2007)
2. Jayakumar, S. 'Materials science', R.K. Publishers, Coimbatore, (2008).

REFERENCES:

Rajendran, V, and Marikani A, 'Materials science' TMH publications, (2004) New delhi.

1. Palanisamy P.K, 'Materials science', Scitech publications (India) Pvt. LTd., Chennai,
2. M.Arumugam, 'Materials Science' Anuradha publications, Kumbakonam, (2006).
3. Charles Kittel, 'Introduction to Solid State Physics', John Wiley & sons, 7th edition, Singapore (2007)
4. Charles P. Poole and Frank J. Ownen, 'Introduction to Nanotechnology', Wiley India (2007)

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyzing and identifying the crystal structure and lattice parameters in solid materials.	2		1		2		2		1		1	2	1	2	2
CO2	Understanding the physical properties and concept of classical and quantum theories for electron behaviour in conducting materials.		1	2	1		1		1	2	2		1		1	1
CO3	Determining the carrier concentration and electrical conductivity of intrinsic and extrinsic semiconductors.	2		1		2		2		1		1	2	1	2	2
CO4	Understanding the various polarization mechanisms in dielectrics and the techniques to manufacture nano materials for engineering applications.	2		1		2		2		1		1	2	1	2	2
CO5	Acquiring the knowledge about nuclear physics in energy production and the phenomenon of thermal conductivity through different media of materials.	2		1		2		2		1		1	2	1	2	2

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215CYT04	APPLIED CHEMISTRY	3	0	0	3	50	50	100

COURSE OBJECTIVES:
- To make the students conversant with basics of polymer chemistry.
- To acquaint the student with concepts of important photo physical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of engineering materials and its applications.
- To acquaint the students with the basics of fuels, and chemistry behind combustion process.
- To make the student acquire sound knowledge of adsorption and its industrial application

UNIT I POLYMER CHEMISTRY   9

Introduction: Classification of polymers – Natural and synthetic; Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Plastics-Thermoplastics and Thermosetting. Preparation, properties and uses of Nylon 6,6, Terylene, polyurethane, BuNa-S, BuNa-N and Epoxy resin. Rubber – Vulcanization of rubber-Advance Polymeric Materials-Electron devices-Conducting and semi conducting polymers-Liquid crystal polymer-applications.

UNIT II PHOTOCHEMISTRY AND SPECTROSCOPY   9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency –Photophysical process-Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation –applications (any 2).

UNIT III ENGINEERING MATERIALS   9

Refractories: definition, characteristics, classification, properties – refractoriness, RUL, dimensional stability, thermal spalling, porosity; Manufacture of alumina, magnesite and Zirconia.
Lubricants: Functions of lubricant – Types of Lubricants –solid lubricants-use of water as a lubricant-plastic lubricant-gaseous lubricants. Mechanism of lubrication- Fluid or Hydrodynamic Lubrication, Thin film or Boundary lubrication & Extreme pressure lubrication. Properties of lubricants – Viscosity –Viscosity Index -Flash and Fire point – Cloud and Pour point – Oiliness - Aniline point-Neutralization number-Mechanical stability.

UNIT IV FUELS AND COMBUSTION   9

Fuel: Introduction- classification of fuels- calorific value- higher and lower calorific values-coal- analysis of coal (proximate and ultimate)- carbonization- manufacture of metallurgical coke (Otto Hoffmann method) – petroleum – Fractional distillation - manufacture of synthetic petrol (Bergius process)- knocking- octane number - diesel oil- cetane number – preparation of biodiesel-trans esterification method- natural gas- compressed natural gas(CNG)- liquefied petroleum gases(LPG). Combustion of fuels – (simple problems) flue gas analysis (ORSAT Method).

UNIT V SURFACE CHEMISTRY AND CATALYSIS   9

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions. Types of isotherms – Frendlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation. Industrial applications of catalysts.

Total Hours: 45

Course Outcomes:

CO1: The knowledge gained on Polymer chemistry
CO2: Understanding the principles of Photochemistry & Spectroscopy
CO3: Recall the behavior of Engineering materials
CO4: Fuels and adsorption will facilitate better understanding of engineering processes and applications for further learning.
CO5: Student acquired sound knowledge in adsorption and its industrial application

Text Books

1. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai and Sons, NewDelhi2004.16th Edition.
2. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry,2ndEdition.PHI Learning PVT., LTD, New Delhi, 2008. 3rd Edition.
3. K. Sivakumar, Applied Chemistry, Sahana Publishers, Coiambatore 2016.1st Edition.

Reference Books

1. S. S. Dara, A Textbook of Engineering Chemistry, S. Chand & Co., Ltd. NewDelhi. 2008. Reprint edition.
2. B. K. Sharma, Engineering Chemistry, 3rd edition Krishna Prakashan Media (P)Ltd., Meerut, 2001.
3. ArunBhal, B.S. Bhal, G. D. Tuli, Essentials of Physical Chemistry, S. Chand & Co., Ltd. New Delhi. 26th Edition.
4. P. W. Atkins & Julio de Paula, Atkins' Physical Chemistry, Oxford University Press York, 7thEdn, 2002.
5. ShashiChawla, A Text Book of Engineering Chemistry, 3rd Edition, DhanpatRai&New Delhi, 2007.

6. S. Vairam, P. Kalyani&Suba Ramesh, Engineering Chemistry, IstEdn, John Wiley &Sons, India, 2011.
7. Lee J.D., Concise Inorganic Chemistry, 7th Edn, Blackwel Science Publications Oxford, London, 2004.

	COURSE OUTCOMES	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	The knowledge gained on Polymer chemistry		1	2	1		1		1	2	2		1		1	1
CO2	Understanding the principles of Photochemistry & Spectroscopy		1	2	1		1		1	2	2		1		1	1
CO3	Recall the behavior of Engineering materials	2		1		2		2		1		1	2	1	2	2
CO4	Fuels and adsorption will facilitate better understanding of engineering processes and applications for further learning.	2		1		2		2		1		1	2	1	2	2
CO5	Student acquired sound knowledge in adsorption and its industrial application		1	2	1		1		1	2	2		1		1	1

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215EGT05	**ENGINEERING GRAPHICS**	2	0	4	4	50	50	100

COURSE OBJECTIVES:

1. The students will learn graphics skill for communication of concepts, ideas and design of engineering products and transform into graphic drawing of concepts, ideas and design of engineering product.
2. To understand the basic principles of technical / engineering drawing.
3. To understand the different steps in producing drawings according to BIS convention.

Concepts and conventions (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – 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 and true 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 one reference plane by change of position method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES   15

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.

Sectioning of simple solids like prisms, pyramids, cylinders and cones in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS   **15**

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

Total Periods:75

COURSE OUTCOMES:

The student will be able to

1. Perform free hand sketching of basic geometrical constructions and multiple views of objects.
2. Do orthographic projection of lines and plane surfaces.
3. Draw projection of solids, section of solids and development of lateral surfaces.
4. Prepare isometric and perspective sections of simple solids.

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, 50th Edition, 2010.

REFERENCE BOOKS:

1. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited, 2008.
2. Gopalakrishnana. K. R, "Engineering Drawing" (Vol. I & II), Subhas Publications, 2010.
3. Natrajan K. V, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

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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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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ELECTRIC CIRCUITS	L	T	P	C	CA	EA	Total
215ESE12	AND ELECTRON DEVICES	3	0	0	3	50	50	100

COURSE OBJECTIVES:
- Analyse the two port networks using different techniques
- Analyse 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

Kirchoff'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 transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
1. Analyze the two port networks using different techniques
2. Compute transient response in RLC circuits

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3. Describe the concept of intrinsic and extrinsic semiconductors and its characteristics
4. Explain the concept of transistor configurations and their applications
5. Recognize the various forms of semiconductors devices and their characteristics

TEXT BOOKS:

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaumseries,Tata McGraw Hill, (2001)

2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).

3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5Th Edition, (2008).

REFERENCES:

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7 th Education, (2006).

2. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering CircuitAnalysis",Tata McGraw Hill, 6th Edition, 2002.

3. J. Millman&Halkins, Satyebranta Jit, "Electronic Devices &Circuits",Tata McGraw Hill, 2nd Edition, 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	

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	CIRCUITS AND	L	T	P	C	CA	EA	Total
215ESP08	DEVICES LABORATORY	0	0	4	2	50	50	100

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. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET.
11. Characteristics of Diac and Triac.
12. 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

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Demonstrate the different Laws for Network circuits	3		3	3										2	
CO2	Demonstrate the different Laws for Network circuits	3		3	3										2	
CO3	Analyze various Theorems for Network circuits	3		3	3										2	
CO4	Determine the frequency response of resonance circuits	3		3	3										2	
CO5	Compute the characteristics of various semiconductor devices	3		3	3										2	

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215HSP13	LANGUAGE LAB	0	0	4	2	50	50	100

COURSE OBJECTIVES:

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their career.

To enhance the performance of the students at Placement Interviews, Group Discussions and other recruitment exercises.

Globalization has brought in numerous opportunities for the teeming millions, with more focus on the students' overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find it difficult to enter corporate world due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping this necessity of pre-employment coaching for career developments of the students in view, this course on Communication Skills Laboratory is designed to prepare the students to adapt themselves with ease to the industry environment, and make them rendering as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them in their profession.

Lecture – Practice – PC based (45 hours)

A. English Language Lab

1. Listening: (3+3)

Listening - Barriers to listening – Types of listening – Fill in the blanks – Listening
Comprehension – Note taking.

2. Reading: (1+6)

Reading – Techniques – Skimming and Scanning – Note making
Review (book – journal – essay – movie etc.,)
Newspaper Reading
Cloze Reading

3. Speaking: (5+15)

Practicing Short Dialogues – Speeches – Interpreting pictures – objects – cartoons –
Telephone etiquette
Tongue twisters
Presentation skills – Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples

Group discussion – Structure of GD – Strategies in GD - Moderator – led and other
GDs — Team work - Body Language - Mock GD -Video samples
Phonetics – Stress and intonation - Common Errors in Spoken English

4. Writing: (2+4)

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Jumbled words

Jumbled Paragraph

Preposition

Concord

Error Spotting

Editing

Letter writing (Covering letter – Follow up letter - Letter of thanks giving - appreciation – gratitude) E-mail Etiquettes

5. Soft Skills (2+4)

Team building – strategies - stages- blocks of an assertive team

Assertiveness , Articulateness

Time management

Stress management

Psychometrics

Course Outcomes:

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

CO1: Students will be able to understand, analyze and interpret the essentiality of grammar.

CO2: Students will be able to build vocabulary by means of communication via direct and indirect communication.

CO3: Students will be able to improve pronunciation skills.

CO4: Students will be able to understand various rules and means of written communication

Text Books:

1. Anderson, P.V, *Technical Communication*, Thomson Wadsworth, 6th Edition, New Delhi, 2007.

2. Prakash, P, *Verbal and Non-Verbal Reasoning*, Macmillan India Ltd., 2nd Edition, New Delhi, 2004.

References:

1. Dhanavel S. P., *English and Soft Skills,* Orient BlackSwan Pvt. Ltd. Hydrabad, 2010.

2. Evans, D, *Decision maker*, Cambridge University Press, 1997.

3. John Seely, *The Oxford Guide to Writing and Speaking*, Oxford University Press, New Delhi, 2004.

4. Thorpe, E, and Thorpe, S, *Objective English*, Pearson Education, Second Edition, New Delhi, 2007.

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COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Students will be able to understand, analyze and interpret the essentiality of grammar.									1	3	2	1			1
CO2	Students will be able to build vocabulary by means of communication via direct and indirect communication.									1	2	2	1			1
CO3	Students will be able to improve pronunciation skills.									1	3	2	1			1
CO4	Students will be able to understand various rules and means of written communication	-								1	3	2	1			

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
315MAT01	ENGINEERING	L	T	P	C	CA	EA	Total
	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.

- 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	

	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	

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   9
            ECOSYSTEM**

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   9
            THE ENVIRONMENT**

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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.

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		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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

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

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

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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

Course Code	Course Title	Hours / Weeks			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
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.

	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		
	LIFE SCIENCES-I	L	T	P	C	CA	EA	Total
315BMP07	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			Credits	Maximum Marks		
		L	T	P	C	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.

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 O1 0	P O1 1	P O1 2	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

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

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	SENSORS AND	L	T	P	C	CA	EA	Total
415BMT03	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	PO1	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

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

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.

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	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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 O1 0	P O1 1	P O1 2	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

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

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	

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

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

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	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O1 0	P O1 1	P O1 2	PS O1	PS O2	PS O3
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

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

Designation: Professional Core Electronics

Pre-requisites: Analog & Digital

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

TOTAL: 45 PERIODS

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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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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		
	DIGITAL SIGNAL	L	T	P	C	CA	EA	Total
515ECT02	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	MICROPROCESSORS	L	T	P	C	CA	EA	Total
515ECT03	AND MICROCONTROLLE RS	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C	CA	EA	Total
515BMT05		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	PO1	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	

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	PO1	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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

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

	Course Outcomes	PO1	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

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	DIGITAL SIGNAL	L	T	P	C	CA	EA	Total
515BMP09	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

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

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 O1 0	P O1 1	P O1 2	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

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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	RADIOLOGICAL	L	T	P	C	CA	EA	Total
615BMT03	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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	PO1	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

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	MEDICAL SAFETY	L	T	P	C	CA	EA	Total
615BME06	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.

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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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615CIO01	COMPUTER NETWORKS	3	0	0	3	50	50	100

COURSE OBJECTIVES:

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

UNIT I   DATA COMMUNICATIONS & PHYSICAL LAYER   **8**

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

UNIT II   DATA LINK LAYER   **10**

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

UNIT III   NETWORK LAYER   **10**

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

UNIT IV   TRANSPORT LAYER   **9**

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

UNIT V   APPLICATION LAYER   **8**

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

TOTAL   HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of data communication and networking
CO2: Explore various flow and error control protocols in data link layer.
CO3: Understand and evaluate the performance of various routing algorithms.
CO4: Analyze flow control and congestion control algorithm for QoS at end to end level.
CO5: Explore the features and operations of various application layer protocols.

TEXT BOOK:

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

REFERENCE BOOKS:

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

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

Course 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	PO1	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Enhancing the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills					1	2			2	3	3				
CO2	Improving their soft skills, including report writing, necessary for the workplace situations					1	2			3	3		3			3
CO3	Creating effective PPTs and presenting the visuals effectively												3			3
CO4	Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report									3	3	2				3
CO5	Enhancing the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills					1			2		3	2				

			L	T	P	C
711BMT01		MEDICAL OPTICS	3	0	0	3

COURSE OBJECTIVES:

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

UNIT I   OPTICAL PROPERTIES OF THE TISSUES   9

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

UNIT II   INSTRUMENTATION IN PHOTONICS   9

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

UNIT III   APPLICATIONS OF LASERS   9

Medical Lasers: Introduction, Laser physics- fundamentals, principles, advances. 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 TOMOGRAPHY   9

Optical coherence tomography, Elastrography, Doppler optical coherence tomography, Application towards clinical imaging.

UNIT V   SPECIAL OPTICAL TECHNIQUES   9

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

                                                              TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Will have an in-depth idea about optical equipments, their principles, appreciate their usage in the therapeutic and surgical units of hospital

CO2: Will be gaining an adequate knowledge about the fundamentals of tissue optical properties

CO3: Will know the different types of lasers and their application in biomedical field and hence the benefit of the society

CO4: Will have in-depth knowledge about different techniques and their impact in society

TEXT BOOKS:

1. Tuan Vo Dirh, "Biomedical photonics – Handbook", CRC Press, Bocaraton, 2003.
2. Laser and optical fibers in Medicine by Abraham Katzir, Academics Press,1998.
3. Mark E. Brezinski., Optical Coherence Tomography: Principles and Applications, Academic Press, 2006.

REFERENCES:

1. Leon Goldman, M.D., & R. James Rockwell, Jr., "Lasers in Medicine", Gordon and Breach, Science Publishers Inc., New York, 1971.
2. Medical Lasers and their safe use DAVID H Shiney .Stephen and L Trokel, Springer, Springer. verlag publications.
3. Elements of fiber optics S.L.Wymer,Regents PHI
4. R. Splinter and B.A Hooper, An Introduction to BioMedicalOptics,Taylor and Francis,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	PS O1	PS O2	PS O3
CO1	Will have an in-depth idea about optical equipments, their principles, appreciate their usage in the therapeutic and surgical units of hospital				3		3			2				2	3	1
CO2	Will be gaining an adequate knowledge about the fundamentals of tissue optical properties	3		3			3							2	3	1
CO3	Will know the different types of lasers and their application in biomedical field and hence the benefit of the society	3		3	3		3							2	3	1
CO4	Will have in-depth knowledge about different techniques and their impact in society	3					3	3						2	3	1

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711BMT02	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques.
- Learn to represent image in form of features.

UNIT I   DIGITAL IMAGE FUNDAMENTAL AND TRANSFORMS   10

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   8

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

TOTAL HOURS : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Know digital image fundamentals.
CO2: Apply image enhancement and restoration techniques.
CO3: Use image compression and segmentation Techniques.

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CO4: Represent features of images.

TEXT BOOK:
1. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing" Pearson education, 2007.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI, 1997

REFERENCES:
1. Willian K. Pratt, "Digital Image Processing", John Wiley, NJ, 1987.
2. Sid Ahmed M. A., "Image Processing Theory, Algorithm and Architectures", McGraw Hill, 1995
3. Scott E. C. Umbaugh, "Computer Vision and Image Processing", Prentice Hall, Eaglewood Cliffs, NJ, 1998.
1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
3. D,E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. Milan Sonka et al, "Image Processing, Analysis and Machine vision", Brookes/Cole, Vikas Publishing House, 2nd edition, 1999
5. Alan C. Bovik, "Handbook of image and video processing" Elsevier Academic press, 2005
6. S.Sridhar, " Digital Image processing" Oxford University press, Edition 2011

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	Know digital image fundamentals.	3				2									3	1
CO2	Apply image enhancement and restoration techniques.				3	3									3	1
CO3	Use image compression and segmentation Techniques.				3	3									3	1
CO4	Represent features of images.	.			3	3									3	1

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	L	T	P	C
711BMT03 **MEDICAL INFORMATICS**	3	0	0	3

COURSE OBJECTIVES:

- Appreciate the role of Informatics in engineering and medicine.
- Understand the importance of Medical information
- Understand soft computing tools to use it for Medical informatics
- Understanding the importance of transmission of medical information
- Understanding the importance of visual Basic in Medical Informatics

UNIT I   MEDICAL INFORMATICS   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   MEDICAL STANDARDS   9

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Electronics Patient Records –Healthcare Standard Organizatios – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNIT III   MEDICAL DATA STORAGE AND AUTOMATION   9

Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface - Medical Data formats – Signal, Image and Video Formats – Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System – PACS

UNIT IV   HEALTH INFORMATICS   9

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education And Training surgery-designing

UNIT V   RECENT TRENDS IN MEDICAL INFORMATICS   9

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment – Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Will have an in-depth idea about information systems
CO2: Will be gaining an adequate knowledge the patient information systems
CO3: Will understand the basic principles to neural networks
CO4: Will gain adequate knowledge about medial data transmission

TEXT BOOKS:

1. R.D.Lele, "Computers in medicine progress in medical informatics", Tata Mcgraw Hill Publishing computers Ltd,2005, New Delhi.
2. Mohan Bansal, "Medicl informatics", Tata Mcgraw Hill Publishing computers Ltd, 2003 New Delhi.
3. N.Mathivanan, "PC-Based Instrumentation", Prentice Hall of India Pvt Ltd – New Delhi – 2007.

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4. Orpita Bosu and Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press, 2007, New Delhi.

5. Yi – Ping Phoebe Chen, "Bioinformatics Technolgies", Springer International Edition, 2007, 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	PS O1	PS O2	PS O3
CO1	Will have an in-depth idea about information systems	3				3				3				0	2	1
CO2	Will be gaining an adequate knowledge the patient information systems	3				3				3				0	2	1
CO3	Will understand the basic principles to neural networks	3												0	2	1
CO4	Will gain adequate knowledge about medial data transmission					3				3				0	2	1

COURSE OBJECTIVES:

- The course will introduce the student to the fundamentals of pattern recognition and its application.
- The course will discuss several supervised and unsupervised algorithms suitable for pattern
- Classification. Particular emphasis will be given to computational methods such as linear discriminant functions and nearest neighbor rule.
- The course also covers basic neural network architectures and learning algorithms, for
- Applications in pattern recognition, image processing, and computer vision.
- The major focus of this course will be on the use of Pattern and Neural Classifiers for classification applications.

UNIT I   **INTRODUCTION AND SUPERVISED LEARNING**   **9**

Overview of Pattern recognition, Types 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- Hierarchial clustering- Single-linkage Algorithm, Complete –linkage Algorithm, Average-linkage algorithm and Ward's method. Partitional clustering- Forgy's Algorithm, k-means algorithm and 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, Adaline and Madaline.

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 Organising Map, Learning Vector Quantisation, 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.

TOTAL HOURS : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of pattern recognition and neural networks.
CO2: Design and apply different pattern recognition techniques to the applications of interest.
CO3: Explain the fundamentals of fuzzy logic.

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TEXT BOOKS:

1. Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt. Ltd., New Delhi , 2002
2. Freeman J.A., and Skapura B.M, " Neural networks, algorithms, applications and programming techniques", Addison – Wesley,2003
3. Duda R.O, Hart P.G, "Pattern classification and scene analysis", Wiley Edition,2000
4. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 1999.
5. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
6. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

REFERENCES:

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

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	Explain the fundamentals of pattern recognition and neural networks.	3				3									3	2
CO2	Design and apply different pattern recognition techniques to the applications of interest.		3	3		3	3			3					3	2
CO3	Explain the fundamentals of Fuzzy logic.	3				2									3	2

		L	T	P	C
711BME05	**ICU AND OPERATION THEATRE EQUIPMENTS**	3	0	0	3

Course Objectives:

1. To study the various ICU equipments
2. To get knowledge about Critical care equipment
3. To gain knowledge about operation theatre equipment.
4. To acquire knowledge about centralised system
5. To understand the concept of patient safety

UNIT I   ICU EQUIPMENT
9

Suction apparatus – Different types; Sterilizers – Chemical, Radiation, Steam for small and large units. Automated drug delivery systems – Infusion pumps, closed loop control infusion system, implantable infusion system.

UNIT II   CRITICAL CARE EQUIPMENT
9

Hemo dialysis Machine – Different types of Dialyzers. Membranes, Machine controls and measurements, Heart Lung Machine – different types of oxygenators, peristaltic pumps, Incubators, Ventilators, Defibrillators

UNIT III   OPERATION THEATRE EQUIPMENT
9

Lighting and table in operation theatres, Surgical monitoring system, Surgical diathermy, Instruments for operation. Anesthesia Equipment – Humidification, Sterilization aspects – Boyles apparatus.

UNIT IV   CENTRALIZED SYSTEMS
9

Centralized Oxygen, Nitrogen, Air supply & Suction. Medical vacuum system, Gas pipeline system, colour coding, regulators. Centralized Air – Conditioning, Oxygen Concentrator, Refrigerator, Water systems in hospitals

UNIT V   PATIENT SAFETY
9

Patient electrical safety – Types of hazards – Natural protective mechanisms against electricity – Leakage current – Inspection of grounding and patient isolation, Hazards in operation rooms – ICCU and IMCUs – Opto couplers and Pulse Transformers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:
1. Study the various ICU equipments
2. Get knowledge about Critical care equipment
3. Gain knowledge about operation theatre equipment.
4. Acquire knowledge about centralised system
5. Understand the concept of patient safety

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TEXT BOOK:

1. Khandapur R S, "Handbook of Bio-Medical Instrumentation", Second Edition, Tata McGraw Hill Publishing Company, Ltd., 2014.

REFERENCE BOOKS:

1. John G Webster, "Medical Instrumentation- Application and Design", John Wiley & Sons, Inc., New York, Third Edition,2010.
2. Joseph Dubovy, "Introduction To Bio-Medical", McGraw Hill Co., 2007.
3. Terry Bahila, "Biomedical And Clinical Engineering", Prentice Hall Inc., 1981.

	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	Study the various ICU equipments	3					2							2	3	1
CO2	Get knowledge about Critical care equipment	3					2							2	3	1
CO3	Gain knowledge about operation theatre equipment.	3					2							2	3	1
CO4	Acquire knowledge about centralised system	3					2							2	3	1
CO5	Understand the concept of patient safety	3					2							2	3	1

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	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I   HUMAN VALUES   9

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

UNIT II   ENGINEERING ETHICS   9

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

UNIT III   ENGINEERING AS SOCIAL EXPERIMENTATION   9

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

UNIT IV   SAFETY, RESPONSIBILITIES AND RIGHTS   9

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

UNIT V   GLOBAL ISSUES   9

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

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to :
CO1: Upon completion of the course, the student should be able to apply ethics in society.
CO3: Discuss the ethical issues related to engineering.
CO3: Realize the responsibilities and rights in the society.

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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	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	Upon completion of the course, the student should be able to apply ethics in society.						2	2	3	1						3
CO2	Discuss the ethical issues related to engineering						2	2	3	1						3
CO3	Realize the responsibilities and rights in the society.						2	2	3	1						3

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711BMP12	DIGITAL IMAGE PROCESSING LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

Software Needed: MATLAB 7.0

COURSE OUTCOMES:

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

CO1: Apply suitable techniques for processing digital images.
CO2: Apply image enhancement and restoration techniques.
CO3: Segment desired region of the image using watershed segmentation and edge detection.

	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	Apply suitable techniques for processing digital images.	3	3		3	3									3	2
CO2	Apply image enhancement and restoration techniques.	3	3		3	3									3	2
CO3	Segment desired region of the image using watershed segmentation and edge detection.	3	3		3	3									3	2

711BMP13	ELECTRONICS DESIGN LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

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

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

TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able to:
CO1: The student will culminate in gaining of major design experience in the related area of specialization.

	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	The student shall 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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811BMT01	HOSPITAL ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To know the planning steps of a new hospital.
- To learn medical equipments maintenance and database in hospitals.
- To know ways of ensuring safety and security in hospitals.
- To understand the various gas supply systems in hospitals.
- To know about various standards of medical equipments and hospital management.

UNIT I   ROLE AND RESPONSIBILITIES OF BIOMEDICAL ENGINEER   9

Hospital various departmental planning &. Design. BME services in hospitals; Role & responsibilities. Biomedical equipment procurement procedure - purchase & contract procedures, selection testing calibration and installation, Training to medical staffs - operating instructions.

UNIT II   MANAGEMENT OF MEDICAL EQUIPMENTS   9

Management of medical equipments, Planned preventive maintenance system, preventive maintenance & repair. Requirements of inter departmental computerization. DBMS in hospital, computerized medical record evaluation, Database approach to laboratory computerization, Case study on a hospital DBMS.

UNIT III   ELECTRICAL SAFETY   9

Hospital electrical supply & power systems-Hospital electrical systems, general power & lighting systems, Hospital wiring systems. Electrical safety, isolated power supply, line isolation monitor, performance testing of isolated power supply, IPS in patient care areas. Generator sets, UPS & voltage stabilizers. Causes of failure of electrical supply ways to minimize them.

UNIT IV   CENTRALIZED AIR CONDITIONING AND GAS SUPPLY SYSTEM   9

Basics of Air conditioning and refrigeration. Air changes filtering & sterility. Hospital gas supply systems-centralized supply of air, oxygen nitrous oxide & vacuum.

UNIT V   MEDICAL DEVICE STANDARDS AND MEDICAL ETHICS   9

NABH procedures and NABH documentation, MDRA and medical device standards, ISO 9001:2000, JCA, ICRP and other standards, medical ethics, labor laws applicable to hospitals.

                                                    TOTAL HOURS : 45 PERIODS

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

CO1: Learnt the planning steps of a new hospital.
CO2: Learnt the medical equipments maintenance and database in hospitals.
CO3: Learnt the ways of ensuring safety and security in hospitals.
CO4: Understood the various gas supply systems in hospitals.
CO5: Learnt about various standards of medical equipments and hospital management.

TEXT BOOKS
1. B.M.Sakharkar, Principles of Hospital Administration & Planning, Medical Publisher Ltd, New Delhi, 1998.
2. J.G. Webster & Albert M.Cook, Clinical Engineering Principles & practices, Prentice Hall, 1979.
3. Barry. N. Feinberg, Applied clinical engineering, Prentice hall, 1986.
4. J. D. Bronzinot Handbook of Biomedical Engineering Vol. I & II, C RC Press, 2000.
5. Yadin David, et a1; Clinical Engineering (Principles and Applications in Engineering),CRC Press, 2003.

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

REFERENCE BOOKS
1. Jacob Kline ed., Hand book of Biomedical Engineering, Academic press, 1988
2. Arora, C.P., Refrigeration and Air Conditioning, McGraw Hill, 3rd edition, New Delhi, 2010.
3. Sharma Yashpal, Hem Chandra, Sharma D.K., Hospital & Medical Gases Management, Ist edition, Bharat Book Centre, Lucknow(UP), 2001.

WEB RESOURCES:

1. http://www.nabh.com
2. http://www.dst.gov.in

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	Know the planning steps of a new hospital.			3			3	3	3	3				0	2	3
CO2	Maintain medical equipments and database in hospitals.						3		3					0	2	3
CO3	Know ways of ensuring safety and security in hospitals.						3		3					0	2	3
CO4	Understand the various gas supply systems in hospitals.	3					2	3						0	2	3
CO5	Know about various standards of medical equipments and hospital management.	3	3							3				0	2	3

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		L	T	P	C
811BME04	ADVANCED MEDICAL INSTRUMENTS	3	0	0	3

Course Objectives:
- To know about computerized healthcare instruments.
- To understand about measurement of various physiological activities.
- To gain knowledge about different analytical techniques.
- To know the latest trends in biomedical instrumentation.

UNIT I   9

Microprocessor based ECG machines. Holter monitoring. Ambulatory monitoring. TMT system. Digital central monitoring systems for patient monitoring, elderly patient monitoring systems.. Design concepts. Advanced computer based arrhythmia detection system-software design protocols.

UNIT II   9

Sound stimulators- Measurement of average auditory evoked potential - application-hotostimulators-Visually evoked potential measurement and application - Recording- Amplifiers - Analysis and storage - Brain mappers (EEG)- principles and measurements, Computerized tonometer, Keratometers.

UNIT III   9

Impedance techniques: Bipolar and retrapolar circuits, detection of physiological activities usingimpedance techniques - cardiac output, neural activity, respiratory activity, impedance plethysmography- resistance and capacitance type. Spirometer. Microprocessor based pulse oximeters.

UNIT IV   9

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

UNIT V   9

Brain–Computer interface, Pervasive Medical Care – Sports, Space, Military applications, Body Area Network.

TOTAL HOURS: 45 PERIODS

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

CO1: Learnt about computerized healthcare instruments.
CO2: Understood about measurement of various physiological activities.
CO3: Gained knowledge about different analytical techniques.
CO4: Learnt the latest trends in biomedical instrumentation.

TEXT BOOKS
1. John G. Webster, Medical Instrumentation Application and Design, Fourth Edition, John Wiley and Sons, Hoboken, NJ, 2009.
2. Keith H. Chiappa, Evoked potential in clinical testing. Third Edition, Lippincott-Raven, 1997.
3. J. D. Bronzino, The Biomedical Engineering Handbook- Vol. 1 & 2, Third Edition, CRC Press, 2006
4. R.S. Kandhpur, Handbook of Analytical Instrumentation, Second Edition, Tata McGraw Hill, New Delhi, 2006.

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5. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.

REFERENCE BOOKS

1. John G. Webster, Haalit Eren, The Measurement, Instrumentation & Sensors Handbook, Second Edition, CRC Press, 2014.
2. IEEE Medical Electronics Monograph Vol. 7 to 12.
3. S. E. Sutphin, Advanced Medical Instrumentation and Equipment, First Edition, Prentice Hall, 1987
4. John D. Enderle, Susan M. Blanchard, Introduction to Biomedical Engineering, Academic Press,1999.
5. Donna Maseric, Neural networks and Artificial Intelligence for Biomedical engineering, Prentice hall of India.
6. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems",Springer, 2013.

COURSE OUTCOMES		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	P C
CO1	Know about computerized healthcare instruments.	3								3				2	3	1
CO2	Understand about measurement of various physiological activities.	3												2	3	1
CO3	Gain knowledge about different analytical techniques.	3		3	3									2	3	1
CO4	Know the latest trends in biomedical instrumentation.	3				3	2	2						2	3	1

COURSE OBJECTIVES:

- To study various mechanical techniques that will help failing heart.
- To learn the functioning of the unit which does the clearance of urea from the blood
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To know the various orthotic devices and prosthetic devices to overcome orthopedic problems.
- 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　　　SENSORY ASSIST DEVICES　　　　　　　　　　　　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, Bionic Eye, Replacement of soft tissues.

UNIT IV　　　PROSTHETIC AND ORTHODIC 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, Gait analysis.

UNIT V　　　RECENT TRENDS　　　　　　　　　　　　　　　9

Transcutaneous electrical nerve stimulator, bio-feedback - EMG, EEG, Electrodermal, Cardiopulmonary, Simulation, applications.

　　　　　　　　　　　　　　　　　　TOTAL HOURS: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Learnt various mechanical techniques that will help failing heart.
CO2: Understood the functioning of the unit which does the clearance of urea from the blood
CO3: Understood the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
CO4: Learnt the various orthotic devices and prosthetic devices to overcome orthopedic problems.
CO5: Understood electrical stimulation techniques used in clinical applications.

TEXT BOOKS:

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

REFERENCE:

Chairman, Board of Studies
Faculty of Bio Medical Engineering (UG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

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

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	Know various mechanical techniques that will help failing heart.	3		3	3									2	3	1
CO2	Understand the functioning of the unit which does the clearance of urea from the blood			3	3									2	3	1
CO3	Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.		3	3										2	3	1
CO4	Know the various orthotic devices and prosthetic devices to overcome orthopedic problems.			3										2	3	1
CO5	Understand electrical stimulation techniques used in clinical applications.					3								2	3	1

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COURSE OBJECTIVES:

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

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

TOTAL HOURS: 210 PERIODS

COURSES OUTCOMES:

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

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

COURSE OUTCOMES		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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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