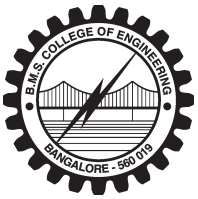

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

(ಸ್ವಾಯತ್ತ ವಿದ್ಯಾ ಸಂಸ್ಥೆ)

ಬುಲ್ ಟೆಂಪಲ್ ರಸ್ತೆ, ಬೆಂಗಳೂರು – 560 019

MEDICAL ELECTRONICE
SCHEME & SYLLABUS FOR
III & VIII SEMESTERS
2009 - 10

BMS COLLEGE OF ENGINEERING

(Autonomous College under VTU)

Bull Temple Road, Bangalore - 560 019

Subject Title	ENGINEERING MATHEMATICS – III	Credits	4
Sub. Code	10MA3ICMAT	L-T-P	3-1-0

Objectives The purpose of the course is to make the students well conversant with Fourier-Series, Fourier Transforms, formulate physical problems in terms of Partial Differential Equations, find insight into the physical behavior of systems from mathematical solution and develop computational skills using efficient numerical methods for problems in science and engineering.

Outcomes Students on completion of the course will

- Exhibit ability to use mathematical techniques and skills to analyze and design complex systems containing hardware and software components as appropriate to engineers.
- Analyze, interpret data and report results for engineering problems.

UNIT I **9 Hours**

FOURIER SERIES

Infinite series, convergence and divergence of infinite series of positive terms, power series, periodic function, Dirichlet's conditions, statement of Fourier Theorem, Fourier series of periodic function of period 2p and arbitrary period, half range Fourier series, complex form of Fourier series, practical harmonic analysis. **(7L+2T)**

UNIT II **9 Hours**

FOURIER TRANSFORM

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms, Convolution theorem (statement only), Parseval's identities for Fourier transform. Fourier transforms of the derivatives of a function. **(7L+2T)**

UNIT III **12 Hours**

PARTIAL DIFFERENTIAL EQUATIONS

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- The linear equation $P\,p + Q\,q = R$ (Lagrange's partial differential equation). Method of separation of variables. **(5L+2T)**

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Derivation of one-dimensional heat equation, wave equation, various possible solutions of these by the method of separation of variables, D'Alembert's solution of wave equation.

(4L+1T)

UNIT IV **11 Hours**

NUMERICAL METHODS

Finite Differences and interpolation: Forward differences, Backward differences.Interpolation: Newton-Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Newton's general interpolation formula, Lagrange's interpolation formula, Lagrange's inverse interpolation. Numerical differentiation: Numerical differentiation using Newton-Gregory forward and backward interpolation formula **(4L+2T)**

Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule, Weddle's rule.

Solution of algebraic and transcendental equations: Ramanujan's method, Newton-Raphson method, deductions.Numerical solution of ordinary differential equations: Euler's modified method, Runge-Kutta method of fourth order. **(4L+1T)**

UNIT V **11 Hours**

Z-TRANSFORMS Definition, Properties, Transforms of standard functions, Inverse transforms.**APPLICATIONS OF Z -TRANSFORMS**Solution of difference equations using Z-transforms. **(4L+2T)**

CALCULUS OF VARIATIONS Variation of function and functional, Euler's equation, variational problem.APPLICATIONS OF CALCULUS OF VARIATIONSGeodesics, minimal surface of revolution, hanging chain, Brachistochrone problem. **(4L+1T)**

TEXT BOOKS:

1. Higher Engineering Mathematics, B.S. Grewal, 40^{th} edition, 2007, Khanna Publishers.

2. Advanced Engineering Mathematics, Erwin Kreyszig, 8^{th} edition, 2007, Wiley-India Introductory methods of Numerical Analysis, S. S. Sastry, 3^{rd} edition, 1999, Prentice-Hall of India.

Unit No.	Text Book	ChapterNo.	Article Number	Page Nos.
I	B.S. Grewal	10	10.1 to 10.7 10.10 to 10.11	429 – 454 456 - 463
II	B.S. Grewal	22	22.1 to 22.2, 22.4 to 22. 7	836 - 851
III	B.S. Grewal	17 18	17.1 to 17.3, 17.5 18.1 to 18.5	632 - 639 657 - 678
IV	B.S. Grewal	29 28 31	29.1(1) to 29.1(2) 29.5 (1) to 29.5(2) 29.8 to 29.10 29.12 28.2(3) 31.1, 31.4 to 31.5, 31.7	1038-1039 1050-1055 1064-1071 1075-1083 1011-1016 1096-1109
IV	S.S. Sastry	2	2.6	38 - 43
V	B.S. Grewal	23 34	23.1 to 23.11, 23.15(I), 23.15(II), 23.16 34.1 to 34.5	 866 - 885 1204-1213

REFERENCE BOOKS:

1. Advanced Modern Engineering Mathematics, Glyn James, 3rd edition, 2004, Pearson Education.

2. Higher Engineering Mathematics, B.V. Ramana, 2007, Tata Mc. Graw Hill.

3. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009,

Cengage learning India Pvt. Ltd.

Subject Title	NETWORK ANALYSIS	Credits	4
Sub. Code	10ES3GCNAL	L-T-P	4-0-0

OBJECTIVE:

The course matter of Network Theory comprises primarily of analysis of electrical networks. Depending on the nature and complexity of a given network, particular techniques of circuit analysis are usually adopted. It gives an insight of how to understand the behavior of networks to different types of excitations and a thorough knowledge of the nature of elements which constitute electrical networks is essential

OUTCOME: After the course is learnt, Student can analyze practical circuits and come out with the necessary solutions and corrections to be incorporated. Also this is a prerequisite for higher semester courses like digital signal processing, control systems, signals and systems, etc.

UNIT I **08 Hours**

Basic Concepts:

Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and node analysis With linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh

UNIT II **10 Hours**

(a)Network Topology: Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set, tie-set & cut-set schedules, Formulation of equilibrium equations, Principle of duality.(b)Resonant Circuits: Series and parallel resonance, frequency response of series and Parallel circuits, Q – factor, Bandwidth

UNIT III **12 Hours**

Network Theorems :

Superposition, Reciprocity ,Millman'sThevinin's and Norton's theorems; Maximum Power transfer theorem.

UNIT IV **10 Hours**

Transient behavior and initial conditions

Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions in RL, RC and RLC circuits Laplace Transformation & ApplicationsReview of Laplace transforms, waveform Synthesis, initial and final value theorems, step, ramp and impulse responses ,convolution theorem, solution of simple R-L,R-C,R-L-C networks for AC and DC excitations using Laplace transforms.

UNIT V **10 Hours**

Two port network parameters and State Variable analysis:

Definition of z, y, h and transmission parameters, modeling with these parameters, relationship between parameters sets. Writing State equations and solution using Laplace transforms.

TEXT BOOKS:

1. "Network Analysis", M. E. Van Valkenburg, PHI / Pearson Education, 3rd Edition. Reprint 2002.
2. "Networks and systems", Roy Choudhury, 2nd edition, 2006 re-print, New Age International Publications.
3. Theory and Problems of Electric Circuits (Schaum Series), 2nd Edition McGraw Hill

REFERENCE BOOKS:

1. "Engineering Circuit Analysis", Hayt, Kemmerly and Durbin,TMH 6th Edition, 2002
2. "Network analysis and Synthesis", Franklin F. Kuo, Wiley
3. "Analysis of Linear Systems", David K. Cheng, Narosa Publishing House, 11th reprint, 2002
4. "Circuits", Bruce Carlson, Thomson Learning, 2000. Reprint 2002

Subject Title	Analog Electronic Circuits	Credits	5
Sub. Code	10ES3GCAEC	L-T-P	4-0-1

Objective: To know about the internal function of Electronic devices and Biasing Methods and Circuit functionality Analysis. To know about the working of circuits using advanced semiconductor devices and about the practical applications of Electronic devices.

Outcome: Student can analyze practical circuits and come out with the necessary solutions and corrections to be incorporated. One could design the circuits for any electronic components used in day to day life.

UNIT I **11 Hours**

Introduction:

Review of Boolean algebra, logic gates.Simplification of Boolean functions : The Map Method, Two and Three Variable Maps, Four Variable Map, Five and Six variable Maps, Product of sums simplification, NAND and NOR implementation, Other Two level implementations, Don't care conditions, The Tabulation Method, Determination of Prime Implicants, Selection of prime implicants , Concluding Remarks

UNIT II **11 Hours**

Combinational Logic Circuits: Introduction,DesignProcedure,Adders, Subtractors, Code conversion, Combinational Logic with MSI and LSI: Introduction, Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, Multiplexers, Programmable Logic Devices, Programmable Read Only memories(PROMs), Programmable Logic Arrays(PLAs), Programmable array logic (PAL).

UNIT III **10 Hours**

Flip-Flops and Simple Flip –Flops Applications: The Basic Bistable Element, Latches, Timing Considerations, Master Slave Flip-Flops(pulse-Triggered Flip-flops), Edge Triggered Flip Flops, Characteristic Equations.

UNIT IV **09 Hours**

Sequential Logic Circuits: Registers, Counters, Design of Synchronous Counters

UNIT V **11 Hours**

Synchronous Sequential circuits: Structure and Operation of Clocked Synchronous sequential Networks, Analysis of clocked synchronous sequential networks, Modeling clocked synchronous sequential network behavior, state table reduction, The state assignment, Completing the design of clocked synchronous sequential networks.

LAB experiments: – Verification of gates, implementation using basic gates and universalgates, Code conversion (Binary to gray, BCD to Excess 3), verify adders, subtracters, multiplexers, demultiplexers, comparators & code converter, verification of Flip flops, counters, shift registers

TEXT BOOKS:

1. Digital logic and computer design- Morris Mano, Prentice Hall
2. Digital Principles and Design- DonaldGivone, Tata McGraw Hill

REFERENCE BOOKS:

1. Fundamental of Logic Design- Charles Roth Jr., Thomas Learning
2. Digital Logic Applications and principles- John Yarbrough, Pearson Education

Subject Title	FUNDAMENTALS OF MICROPROCESSORS	Credits	4
Sub. Code	10ES3GCFMP	L-T-P	3-0-1

UNIT I **08 Hours**

Architecture and Operation: Introduction to 8085, Microprocessor organization/architecture& its operation, Microprocessor-based system, Memory interfacing, basic interfacing concepts, Interfacing I/O devices *Programming:* Programming model. Instruction classification, Instruction Format, addressing modes.Writing Assembly level programs - overview of instruction set, timing diagrams. Data Transfer, Arithmetic, Logic branch operations..

UNIT II **08 Hours**

Programming Techniques - Looping, Counting and Indexing, 16 bit arithmetic operations, logic operations, Compare and rotate operations. Counters and Time Delays, Generation of pulse waveforms.Stacks and subroutines - Conditional CALL and RETURN instructions.Advanced Subroutine concepts. BCD to Binary and Binary to BCD conversions, BCD to 7 segment conversion. Binary to ASCII and ASCII code conversion, BCD addition and subtraction, multiplication and division

UNIT III **07 Hours**

Memory Interface: Memory and I/O mapping and interfacing concepts.Interrupts: 8085 vectored interrupts, Restart as software instructions, Additional I/O concepts and processes.

UNIT IV **08 Hours**

Interfacing of peripherals (1/Os) and applications: Interfacing Keyboard and 7 segment display including multiplexers,The 8279 programmable keyboard / display interface. 8255 Programmable Peripheral Interface

UNIT V **08 Hours**

8253 interfacing, 8259 Programmable interrupt controller, DMA and 8257 DMA controller, Serial communication using 8251, D to A converters, A to D converters and interfacing.

Lab experiments:- Data transfer instructions, block move block exchange, sorting an array, addition, subtraction, multiplication, division, counters logic and rotate instructions, conditional CALL and RETURN instructions, code conversion

TEXT BOOK:R. S. Gaonkar, "Microprocessor Architecture, Programming and Application with 8085", Penram Int.3rdEdn.

REFERENCE BOOKS: Douglas V. Hall, "Microprocessors and digital systems", MILAditya P. Mathur, /'Introduction to microprocessors", 3rd edition, TMH

Subject Title	MEASUREMENT TECHNIQUES	Credits	3
Sub. Code	09ES3GCMST	L-T-P	3-0-0

UNIT I **07 Hours**

Fundamentals of Measurement

0Introduction, Static Characteristics, Dynamic Characteristics, Errors in measurement, Types of errors, Sources of error. *Electrical Measuring Instruments:*Types of Instruments, Principle of Operation, Constructional features of PMMC instrument, shunts & multipliers, universal shunt, multi range voltmeters.

UNIT II **08 Hours**

Electronic Measuring Instruments:

Need for electronic measuring instruments, True RMS responding voltmeter, Digital voltmeters-Ramp Type, Integrating Type, Successive Approximation Type, Q meter, Digital Multimeter - Block Diagram description.

UNIT III **08 Hours**

Measurement of Resistance, Inductance & Capacitance:

Wheatstone's Bridge- Sensitivity analysis, Limitations, Kelvin's Double Bridge, Maxwells Bridge, Schering Bridge, sources & Detectors, Minimization of AC Bridge Errors, Problems.

UNIT IV **08 Hours**

Transducers -I:

Classification & Selection, Principle of operation of Thermocouples, Resistance Temperature Detectors, Thermistors, LVDT, Capacitive Transducers, Piezoelectric Transducers.

UNIT V **08 Hours**

Transducers -II:

Strain Gauges- Types, Expression for gauge factor, Photosensitive Devices. Display Devices &Recorders : Method of Measuring Amplitude, Phase, Frequency & Period using CRO. Use of Lissajous Patterns. LCD & LED displays, Strip Chart & X-Y Recorders. Introduction to Printers.

TEXT BOOKS:

1. Modern Electronic Instrumentation & Measurement Technique- Albert D. Helfrick, William D. Cooper, 3/e, Pearson, Prentice Hall .
2. Electronic Instrumentation- H. S. Kalsi, Tata McGraw Hill.

REFERENCE BOOKS:

1. A Course in Electrical & Electronic Measurements & Instrumentation- A. K. Sawhney, 18/e, DhanpatRai& Co., New Delhi.
2. Electronic Instrumentation & Measurement- by David A. Bell, 2/e, PHI Publications.

Subject Title	ENGINEERING MATHEMATICS – IV	Credits	4
Sub. Code	10MA4ICMAT	L-T-P	3-1-0

Objectives

To prepare students with adequate knowledge in mathematics to succeed in industry and provide necessary platform to pursue academics, keeping pace with global standards. Topics spanned are Probability and Statistics, Complex Analysis and series solution of Differential Equations. The thrust is to identify and clarify concepts of mathematics needed for the graduation program.

Outcomes

Students on completion of the course will

- Demonstrate an ability to combine fundamental knowledge of engineering principles and mathematical techniques to identify, formulate and solve problems in Engineering.

UNIT I **10 Hours**

STATISTICS

Curve fitting – Fitting a straight line, fitting of a parabola, fitting of curves of the form $a\,b^x, a\,x^b,\ ae^{bx}$. Correlation, regression. **(4L+1T)**

PROBABILITY 1: Probability of an event, axiomatic definition, addition theorem, conditional probability, multiplication theorem, Bayes' theorem. **(4L+2T)**

UNIT II **12 Hours**

PROBABILITY 2

Probability distributions: Random variables, Discrete probability distributions, continuous probability distributions, Some standard distributions: Binomial distribution, Poission distribution, exponential distribution, normal distribution. **(7L+2T)**

UNIT III **10 Hours**

COMPLEX ANALYSIS 1

Function of a complex variable, Analytic functions, Cauchy-Riemann equations, construction of analytic functions, Cauchy-Reimann equations in Polar form.

APPLICATION TO FLOW PROBLEMS: Complex potential, velocity potential, equipotential lines, stream functions, stream lines.Transformations- $w = z^2$, $w = e^z$ and $w = z + \frac{a^2}{z}\ (z \neq 0)$, Bilinear transformations. **(8L+2T)**

UNIT IV **10 Hours**

COMPLEX ANALYSIS 2

Complex integration-Cauchy's theorem, Cauchy's integral formula, Taylor's and Laurent's series, Singular points, poles, residues, the residue theorem. **(5L+2T)**

SERIES SOLUTION OF DIFFERENTIAL EQUATIONS: Series solution-Frobenius method, series solution of Bessel's differential equation leading to Bessel function of first kind, equations reducible to Bessel's differential equation, series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula. **(4L+1T)**

UNIT V **10 Hours**

OPTIMIZATION

Linear programming, mathematical formulation of linear programming problem (LPP), graphical method, simplex method, artificial variable technique- M method, two phase method.

(7L+3T)

TEXT BOOKS:

Higher Engineering Mathematics, B.S. Grewal, 40th edition, 2007, Khanna Publishers.Advanced Engineering Mathematics, Erwin Kreyszig, 8th edition, 2007, Wiley-IndiaUnit No.Text BookChapterNo.Article NumberPage Nos.IB.S. Grewal2424.1, 24.4 to 24.6886 – 8992525.12 to 25.14924 – 932935 -9362626.2 to 26.6938 - 952IIB.S. Grewal2626.7 to 26.10(2), 26.14 to 26.16, 26.19(6)952 - 981IIIB.S. Grewal2020.1 to 20.7, 20.8(4), 20.9 to 20.10738 - 760IVB.S. Grewal2020.12 to 20.14, 20.16 (2) to 20.19762 - 7841616.1 to 16.5, 16.8, 16.13 to 16.14591-617VB.S. Grewal3333.1 to 33.9(1)1144 – 11721176-1177

REFERENCE BOOKS:

Advanced Modern Engineering Mathematics, Glyn James, 3rd edition, 2004, Pearson Education.Higher Engineering Mathematics, B.V. Ramana, 2007, Tata Mc. Graw Hill.Advanced Engineering Mathematics, P. V. O' Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.

Subject Title	**OP AMPS AND LINEAR ICS**	**Credits**	**5**
Sub. Code	**09ES4GCLIC**	**L-T-P**	**4-0-1**

OBJECTIVES: Understand the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals. To introduce the basic building blocks of linear integrated circuits. To understand linear and non-linear applications of operational amplifiers. To introduce the concepts of waveform generation and some special function of ICs.

OUTCOME: Able to understand the functions and working of internal blocks of Op-Amp 741 and 555 Timer IC's. Able To design circuits of Linear and Non linear Applications of using Op amps.

UNIT I **11 Hours**

OPERATIONAL AMPLIFIER FUNDAMENTALS: Operational Amplifier Description, basic operational Amplifier circuit, input and output voltage, common mode and supply rejection, offset voltages and currents, input and output impedances, slew rate and Frequency limitations.OPAMPS AS DC AMPLIFIERS: Biasing operational :Amplifiers, Direct coupled voltage followers, Direct coupled non-inverting amplifiers, Direct coupled inverting amplifiers, summing amplifiers, Difference amplifiers

UNIT II **11 Hours**

DIFFERENTIATING AND INTEGRATING CIRCUITS: Differentiating circuit, Differentiator Design, Differentiating circuit Performance, Integrating Circuit, Integrator Design, Integrating Circuit performance

SIGNAL PROCESSING CIRCUITS : Precision Half wave and Full: wave Rectifiers, Limiting Circuits, Clamping circuits, peak Detectors, sample and hold circuit

UNIT III **10 Hours**

OP:AMP NON LINEAR CIRCUITS: op:amp and switching circuits, crossing detectors, inverting and non:inverting Schmitt trigger circuits, Astable and Monostable Multivibrator.SIGNAL GENERATORS: Triangular/rectangular wave generator , waveform Generator Design, phase shift oscillator, oscillator amplitude stabilization, wien bridge oscillator, Signal Generator output control.

UNIT IV **10 Hours**

ACTIVE FILTERS: All pass phase shifting circuits, 1st order low:pass active filter, 2nd order low pass filter, 1st & 2nd order high pass filter

VOLTAGE REGULATORS: Introduction, Series Op:Amp Regulator, IC voltage Regulators, 723 General purpose Regulator.

UNIT V **10 Hours**

555 TIMER: Introduction, Description of Functional Diagram, Monostable and Astable Operation, Schmitt trigger.

A/D AND D/A CONVERTERS: Introduction , Basic DAC Techniques, A:D Converters, DAC/ADC Specifications.

LAB EXPERIMENTS:

Inverting amplifier, non:inverting amplifier, summing amplifier and voltage follower, precision halfwave and full wave rectifier, limiting circuits, clamping circuits, peak detectors, sample:and:hold circuits, differentiator and integrator, Schmitt trigger and zero crossing detector, Wien bridge oscillator, first order low:pass and high pass filter, IC 723 low voltage and high voltage regulator Simulation experiments using Labview/P-Spice.

TEXT BOOKS:

1. Operational Amplifiers and Linear IC's : David A.Bell, 2nd ed, PHI/Pearson, 2004.
2. Linear Integrated circuits: D.RoyChoudhury and Shail B.Jain,2nded, Reprint 2006, New Age International.

REFERENCE BOOK:

Op:Amps and Linear Integrated Circuits: Ramakanth A.Gayakwad,4th ed,PHI

Subject Title	MICROCONTROLLERS	Credits	4
Sub. Code	10ES4GCMCL	L-T-P	3-0-1

UNIT I **08 Hours**

INTRODUCTION TO MICROCONTROLLERS:

Microprocessors and microcontroller.Introduction,Difference between Microprocessors and Microcontrollers, A. RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture. Embedded Electronic Systems and Microcontrollers, comparison of Different microcontrollers and applications. The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input / Output Pins, Ports and Circuits, External Memory.

UNIT II **08 Hours**

ASSEMBLY LANGUAGE PROGRAMMING IN 8051

Addressing Modes and Instruction set: Introduction, Addressing modes, Data transfer instructions, Example Problems, Arithmetic instructions, Logical instructions, Example Problems, JUMP and CALL Program range, Jumps, calls and Subroutines, Returns, Example Problems .

UNIT III **08 Hours**

EMBEDDED 'C' PROGRAMMING :8051 programming in C: Data types and time delays in 8051 C, I/O programming, logic operations, data conversion programs, accessing code ROM space, data serialization. Timer / Counter Programming in 8051: Counters and timers programming 8051 Timers, Counter Programming, programming timers 0 and 1 in 8051 C

UNIT IV **08 Hours**

8051 Serial Communication: Basics of Serial Communication- Serial data input/output, 8051 connections to RS-232, 8051 Serial communication Programming, Interrupts Programming:, 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt programming in C.

UNIT V **07 Hours**

8051 INTERFACING AND APPLICATIONS: Interfacing 8051 to LCD, Keyboard, DAC, ADC, Stepper motor, DC motor interfacing and PWM.

LABORATORY EXPERIMENTS:A. Data Transfer , Logical-Byte/Bit manipulations ,Jump and Subroutine Calls using Assembly.B. Interfacing: Counters and generate delay using timers, LCD Display, Stepper motor control using interrupt, Serial transmission/Receiving of Number of characters using serial interrupt , Temperature Controller interface, Elevator interface and & segment interface.The Experiments will be implemented using 'Keil' software with Embedded IDE. For interfacing 8051 target board is used.

TEXT BOOKS: "The 8051 Microcontroller Architecture, Programming & Applications", Kenneth J. Ayala 2e, Penram International, 1996 / Thomson Learning 2005"The 8051 Microcontroller and Embedded Systems – using assembly and C ", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.

REFERENCE BOOKS:"Programming and Customizing the 8051 Microcontroller", Predko ;, TMH"Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005"PIC Microcontrollers", 3.J.B. Peatman;" PHI, 2006

Subject Title	**SIGNALS AND SYSTEMS**	**Credits**	**4**
Sub. Code	**09ES4GCSAS**	**L-T-P**	**4-0-0**

OBJECTIVE: To explore the effect of transformation of the signal parameters (amplitude-scaling, Tim e-scaling and time shifting). To explore the computation of even and odd symmetries in a signal with algebraic operations. To visualize the complex exponential signal. To explore the various properties of their impulse signals.

OUTCOMES: To highlight the difference between the continuous –time and discrete-time impulse signals. To demonstrate relationship among complex exponential signal and real sinusoids.

UNIT I **10 Hours**

INTRODUCTION: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems.

UNIT II **12 Hours**

TIME-DOMAIN REPRESENTATIONS FOR LTI SYSTEMS: Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of impulse response representation, Differential and difference equation Representations, Block diagram representations.

UNIT III **12 Hours**

FOURIER REPRESENTATION FOR SIGNALS - 1 : Introduction, Discrete time and continuous time Fourier series (derivation of series excluded) and their properties .

FOURIER REPRESENTATION FOR SIGNALS – 2: Discrete and continuous Fourier transforms(derivations of transforms are excluded) and their properties.

UNIT IV **08 Hours**

APPLICATIONS OF FOURIER REPRESENTATIONS: Introduction, Frequency response of LTI systems, Fourier transform representation of periodic signals, Fourier transform representation of discrete time signals

UNIT V **10 Hours**

Z-TRANSFORMS – 1: Introduction, Z – transform, properties of ROC, properties of Z – transforms, inversion of Z–transforms.

Z-TRANSFORMS – 2: Transform analysis of LTI Systems, unilateral Z- Transform and its application to solve difference equations.

TEXT BOOK: Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2001.Reprint 2002

REFERENCE BOOKS:

1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002
2. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006
3. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005
4. Ganesh Rao and SatishTunga, "Signals and Systems", Sanguine Technical Publishers, 2004

Subject Title	CONTROL SYSTEMS	Credits	4
Sub. Code	09ES4GCCST	L-T-P	4-0-0

Objective: This course deals mainly deals with the details of the Stability of any Mechanical, Electrical or any other system. One could learn the design and mathematical modeling of system of Electrical Networks, Linear Mechanical Networks, Mechanical Coupling Devices and Electro-Mechanical Systems. Furthermore, there is Introduction of Stability concepts and type of Analysis done for Stability and how to maintain stability. This course also fairly gives introduction of Time and frequency domain Analysis.

Outcome: After learning these concepts, one could analyze the real practical situations given about any such systems and can comment and maintain the stability of the system which is the main concern for an engineer.

UNIT I **12 Hours**

INTRODUCTION: Examples of Control Systems, open loop vs Closed loop Systems, Classifications of Control Systems. Mathematical Modeling of Linear Systems: Transfer functions, Mechanical Systems, Analogous Systems, Block diagram, Signal Flow graph (excluding gear trains lever).

UNIT II **10 Hours**

TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS : Step response of first order, second order systems, response specification , steady state error and error constants

UNIT III **10 Hours**

STABILITY ANALYSIS: Concept of stability, RH criterion, applications of RH criterion with limitations, Nyquist plot, Polar plots, Stability Analysis using Nyquist criterion.

UNIT IV **10 Hours**

ROOT LOCUS TECHNIQUE: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot

UNIT V **10 Hours**

FREQUENCY RESPONSE ANALYSIS: Bode plots, Relative stability, Frequency domain specification.

TEXT BOOK: Control Engineering by Nagrath & Gopal, New Age International Publishers

REFERENCE BOOKS: Modern control Engineering- Ogata, Prentice HallAutomatic Control Systems- B.C Kuo, John Wiley and Sons

Subject Title	**FUNDAMENTALS OF HDL**	**Credits**	**4**
Sub. Code	**09ES4GCHDL**	**L-T-P**	**3-0-1**

OBJECTIVE: Provide basic knowledge necessary to understand how to simulate systems using hardware description languages. Systems here include digital logic circuits, such as adders, multiplexers, flip-flops, sequential state machines, biological mechanisms that describe the operation of organs, mathematical models like factorial, greatest no and polynomials

OUTCOME: Students are able to understand how to synthesize-xst, implement and to generate a programming file on to target board to build a digital systems.

UNIT I **07 Hours**

INTRODUCTION: Why HDL? , A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Brief comparison of VHDL and Verilog.

UNIT II **08 Hours**

DATA-FLOW DESCRIPTIONS: Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors. Behavioral Descriptions: Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements.

UNIT III **08 Hours**

STRUCTURAL DESCRIPTIONS: Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements.

UNIT IV **08 Hours**

PROCEDURES AND FUNCTIONS: rocedures, Tasks, and Functions: Highlights of Procedures, tasks, and Functions, Procedures and tasks, Functions. Advanced HDL Descriptions: File Processing, Examples of File Processing.

UNIT V **08 Hours**

SYNTHESIS BASICS: Highlights of Synthesis, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain.

LAB Experiments: Verification of combinational logic circuits, sequential circuits using data flow and sequential descriptions & structural descriptions. Interfacing experiments : stepper motor, dc motor, relay, waveform generation.

TEXT BOOK:HDL Programming (VHDL and Verilog)-NazeihM.Botros- Dreamtech Press (Available through John Wiley – India and Thomson Learning), 2006 Edition

REFERENCE BOOKS:1. Verilog HDL -Samir Palnitkar, Pearson Education2. VHDL -Douglas Perry,TMH3. Fundamentals of Digital Logic with Verilog Design-Stephen Brown, TMH4. Circuit Design with VHDL-VolneiA.Pedroni, PHI

BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

V SEMESTER

MEDICAL ELECTRONICS

Subject Title	LASERS AND FIBER OPTICS IN MEDICINE	Credits	3
Sub. Code	111ML5DCLFO	L-T-P	3-0-0

Objectives: This course gives an insight about the laser and its principles as well as its application in medicine for diagnosis and therapy. Fiber optics is a technology for communication of information with high capacity optical fibers. In this course there will be an introduction of the basic principles of Fiber optics and its fundamentals. A detail description of Endoscopy is also discussed with its principles and applications. If one enjoy basic science, have an interest in how things work, like to work with high-tech equipment, and want a career on the leading edge of technology, this course could be very helpful.

Outcome: Once the course is learnt, the student will be able to know the basics of lasers and fiber optics as well as endoscopy which will be very useful in understanding the medicine applications discussed. However the basics learnt will be useful for the applications in Telecommunications, Aerospace, Electronics, and Electrical and so on.

UNIT I **07 Hours**

Medical Lasers: Introduction, Laser physics-fundamentals, principles, Medical Laser Systems-solid state laser, gas laser, dye laser, semiconductor laser, Laser safety.

UNIT II **07 Hours**

Laser interaction with tissue- photocoagulation, photo thermal ablation, photochemical ablation photo disruption

UNIT III **07 Hours**

Laser Applications in Medical Therapy- application in dermatology, ophthalmology, general surgery, cardiovascular surgery, tumour surgery, gynecology

UNIT IV **10 Hours**

Optical Fibers: Elements of optical fiber transmission link**,**Basic Optical Laws and Definations,optical fiber mode and configurations, Fiber materials,Fiber fabrication, signal degradation in optical fibers

,connectors ,splices and couplers,Optical Fiber Bundles**:** Introduction, non-ordered fiber optic bundles for light guides-fundamentals & principles, ordered fiberoptic bundles for imaging devices-fundamentals & principles, fiberscopes

UNIT V **08 Hours**

Endoscopy: Introduction, fundamentals, principles, types of endoscopes, Clinical Applications of Fiber Optic Laser Systems**:** in gastroenterology, neurosurgery, oncology, ophthalmology, orthopedics, otolaryngology (ENT), urology,

TEXT BOOKS:

1. Lasers and Optical Fibers in Medicine by Abraham Katzir, Academic Press, 1998.
2. Handbook of Biomedical Instrumentation, by R.S.Khandpur, 2nd edition,
3. Optical Fiber communications, by Gerd Keiser, 3rd editionMcGraw-Hill International Editions

REFERENCE BOOKS:

1. Therapeutic Lasers – Theory and practice by G.David Baxter, Churchill Livingstone Publications.
2. Biomedical Instrumentation- Ar.M.Armugam
3. David H Shiney, Stephen and L.Trokel, Springer – Medical Lasers and their safe use, Springer Verlag publications
4. S.K.Venkata Ram- Biomedical Electronics and Instrumentation,Galgotia publications.

Subject Title	Digital Signal Processing	Credits	5
Sub. Code	10ES5GCDSP	L-T-P	4-0-1

OBJECTIVES: The objective of this course is to provide a coherent and structured presentation of the theory and applications of signal processing and noise reduction methods. The theory and application of signal processing is concerned with the identification, modelling and utilization of patterns and structures in a signal process. The observation signals are often distorted, incomplete and noisy. Hence noise reduction and removal of channel distortion is an important role of signal processing.

OUTCOME: To implement and visualize the same using the MATLAB or C Programs.

UNIT I **11 Hours**

Introduction to DSP, Sampling and reconstruction of a discrete time signal in the frequency domain. Definition of Discrete Fourier Transform (DFT). Useful properties of DFT **:** linearity, circular shift, Multiplication by a complex exponential sequence, Properties of even and odd parts of x[n], Multiplication, Parseval's relation, Circular convolution in the time domain ,use of tabular arrays and circular arrays.

UNIT II **10 Hours**

Use of DFT in linear filtering, linear convolution of two finite duration sequences, overlap add and save methods**.** Relation between DFT and other transforms. Direct computation of DFT. Necessity for efficient computation of DFT. Radix 2 Fast Fourier Transform (FFT) algorithm for DFT computation. Decimation in time algorithm, decimation in frequency algorithms.

UNIT III **10 Hours**

Computation of 2N point DFT of a real sequence using single N point DFT**.** Computation of N point DFT of a real sequence using N point DFT. Decomposition for 'N', a composite number,. Number of computations, number of multiplications, computational efficiency, Radix 2 FFT algorithm for computation of Inverse Discrete Fourier Transform. (IDFT).

UNIT IV **11 Hours**

Introduction to realization of digital systems, block diagrams, representation, Realization of Infinite Impulse Response (IIR) systems **:** direct form, parallel form, cascade form**.**

Introduction to IIR filters, impulse invariant & bilinear transformations, Design of analog filters: Design of Digital filters: Butterworth and Chebyshev. Frequency transformations**.**

UNIT V **10 Hours**

Realization of Finite Impulse Response (FIR) systems **:** Direct Form, Linear Phase Form. Introduction to FIR filters, Frequency response of ideal digital low pass filter, high pass filter, frequency sampling technique of designing FIR filters, Windowing,. Design of FIR filters using rectangular , triangular, Hamming, Hanning and Blackman window. Gibbs phenomenon (qualitative discussion only), comparison between IIR and FIR filters.

LAB EXPERIMENTS: Display of basic elementary signals, sampling theorem, basic operations on sequences (shifting, folding, time scaling and multiplication), linear and circular convolution, cross and auto correlation, linear convolution and correction using FFT algorithm, FFT of Sequence, FIR Filter design-LP,HP,BP and Notch filter, FIR filter design using Hamming and Kaiser window for the given order and cut-off frequency, Design of IIR FILTER-LP,HP (using both hardware and software).

TEXT BOOKS:

1. **Digital Signal Processing,** A computer based approach, Sanjit K Mitra, Tata McGrawHill, Third Edition**,**

2. **Digital Signal Processing, Principles, Algorithms and Applications,** John G. Proakis, Dimitris K Manolakis,, Pearson education/PHI, (4th Edition)

REFERENCE BOOKS:

1. **Fundamentals of Digital Signal Processing,** Lonnie Ludeman, John Wiley & Sons; Wiley International 1st Edition, 1988.

2. **Discrete-Time Signal Processing,** Alan V. Oppenheim, Ronald W. Schafer, John R. Buck, Prentice-Hall Signal Processing Series, 2nd Edition**,** 1999

3. **Understanding Digital Signal Processing,** Richard G. Lyons Prentice Hall, March 25, 2nd Edition 2004

4. **Digital Signal Processing: Fundamentals and Applications,** Li Tan, Academic Press, 1st edition 2007

5. **Schaum's Outline of Digital Signal Processing,** Monson Hayes, McGraw- Hill, 1st edition, 1998)

Subject Title	MEDICAL SCIENCE	Credits	4
Sub. Code	11ML5DCMDS	L-T-P	4-0-0

OBJECTIVE: This course is designed to provide students with a basic understanding of the structure, function and disorders of the human body. To become familiar with essential concepts including structure and functional level of organization and homeostasis. To provide an introduction to the language of anatomy and physiology and use anatomical terms fluently when describing different tissues and organs.

OUTCOME: The student will have the understanding of the anatomy and histology and organization of cell, tissues, and organ systems and be able to recognize the gross and microscopic anatomy of the tissues and organs and also demonstrate how different tissue types interact to create organs.

UNIT I **08 Hours**

Introduction: Homeostasis, Tissue, Cartilage: The internal environment and homeostasis, movement of substances within the body, body fluids, action potential, propagation of action potential. Epithelial tissue- simple epithelium, stratified epithelium, connective tissue- cells of connective tissue, loose connective tissue, Adipose tissue, Dense connective tissue, Lymphoid tissue, Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage.

Nervous System: Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: neuroglia, meninges, ventricles of the brain and CSF. Brain: Cerebrum, functions of cerebrum, functional areas of the cerebrum. Brainstem: Cerebellum, Spinal cord- grey matter, white matter, motor nerve tracts, spinal nerves: nerve roots, plexuses, cranial nerves. Autonomic nervous system (in brief)- functions and effects.

UNIT II **08 Hours**

Cardiovascular System: Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, capillaries and sinusoids, control of blood vessel diameter, blood supply- internal respiration, cell nutrition. Heartposition, structure- pericardium, myocardium, endocardium, interior of the heart,

flow of blood through the heart, blood supply to heart, Conducting system of the heart, factors affecting heart rate, the Cardiac cycle, cardiac output, blood pressure, control of blood pressure, pulse and factors affecting the pulse rate. Circulation of the blood- pulmonary circulation, systemic circulation, aorta, circulation of blood to head and neck, circulation of blood to upper limb, portal circulation.

UNIT III **08 Hours**

Digestive System: Introduction, Organs of the digestive system- mouth: tongue, teeth, salivary glands, pharynx, oesophagus, stomach, gastric juice and functions of stomach- small intestine: structure, chemical digestion in small intestine, large intestine: structure, functions of the large intestine, rectum and anal canal. Pancreas, Liver.

UNIT IV **08 Hours**

Respiratory System: Introduction, Nose and Nasal cavity- position, structure and functions, pharynx, position, structure, functions. Larynx: position, structure and functions. Trachea, bronchi, bronchioles and alveoli, lungs- position, associated structure, pleura and pleural cavity. Respiration muscles of respiration cycle of respiration, variables affecting respiration, lung volumes and capacity.

Endocrine, Urinary and Reproductive System: Pituitary gland, thyroid gland, parathyroid gland, adrenal gland. Parts of urinary system, kidneys organs associated with the kidneys, gross and microscopic structure of the kidney, functions of the kidneys, ureter, urinary bladder, urethra, micturition.

UNIT V **07 Hours**

Skeletal System: Bone, Types of bone, structure, bone cells, functions of bone. Axial skeleton- skull, sinuses, Fontanelles, vertebral column characteristics of typical vertebra, different parts of vertebral column (parts only), features of vertebral column, movements and functions of vertebral column, sternum, ribs, shoulder girdle and upper limb, pelvic girdle and lower limb.

Muscles and Joints (Study of muscles along with joints): Muscle tissue: Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue, muscle tone and fatigue. Types of

joint- Fibrous, Cartilaginous, Synovial, characteristics of synovial joints, shoulder joint, elbow joint, radioulnar joint, wrist joint, joints of hands and fingers, Hip joint, Knee joint, ankle joint, joints of foot and toes.

TEXT BOOK: Ross& Wilson's Anatomy and Physiology in Health and Illness – by Anne Waugh and Allison Grant, 9th Edition, Churchill Livingstone Publications.

REFERENCE BOOKS:

1. Concise Medical Physiology- by Sujit K. Chaudhuri, 5th Edition, New Central Book Agency Pvt. Ltd.
2. Essentials of Medical Physiology - by K. Sembulingam and PremaSembulingam, 3rd Edition, Jaypee Publications.
3. Human Physiology: From Cells to Systems - by Lauralee Sherwood, 6th Edition, Brooks Cole Publication.

Subject Title	**BIOMEDICAL INSTRUMENTATION**	**Credits**	**5**
Sub. Code	**10ML5DCBMI**	**L-T-P**	**4-0-1**

Objectives: Understand the need & advantages Electrodes and Transduers used for Biosignal Acquisition. Understanding about the Instruments used for Cardiovascular Measurments. Understanding about EMG and EEG Measurements and its significance. Understanding about Blood flow meaurements and common Devices used in Medical industry.

Outcome: Should be able to design various circuits used for cardiovascular measurements such as Isolation Amplifiers and Instumentation Amplifiers. To be able to understand the various measurement parameters such as Blood pressure, PH, Heart rate, Respiratory Measurements and Biomedical Signals measurements.

UNIT I **10 Hours**

Fundamental Concepts: Sources of biomedical signals, Basic medical instrumentation system, performance requirements of medical instrumentation systems, Intelligent medical instrumentation Systems, General constraints in design of medical instrumentation systems. Bioelectric Signals

and Electrodes: Origin of Bioelectric signals - Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.

UNIT II **10 Hours**

Physiological Transducers: Classification of transducers, performance characteristics of transducers. Pressure transducers, transducers for body temperature measurement, photoelectric transducers, optical fiber sensor, biosensor and smart sensor. Biomedical Recorders: Electrocardiograph, vectorcardiograph, phonocardiograph, Electroencephalograph, Electromyograph, other biomedical recorders and biofeedback instruments.

UNIT III **08 Hours**

Patient Monitoring Systems**:** System concepts, cardiac monitor, bedside patient monitoring system, central monitors, measurement of heart rate, measurement of pulse rate, blood pressure measurement, measurement of temperature, measurement of respiratory rate, catheterization laboratory instrumentation.

UNIT IV **12 Hours**

Oximeters: Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter. Blood Flow Meters: Electromagnetic blood flow meters-different types, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. Cardiac output measurements: Indicator dilution method, Dye dilution method, Thermal dilution techniques, Measurement of continuous cardiac output derived from the aortic pressure waveform, Impedance technique. Pulmonary Function Analyzer: Pulmonary function measurement, Spirometry, Pneumotachometer, Measurement of volume by Nitrogen washout technique.

UNIT V **12 Hours**

Blood Gas Analyzers: Acid-base balance, blood pH measurement, measurement of blood pCO_2, intra-arterial blood gas monitoring, complete blood gas analyzer, Blood cell counters: Types of

blood cells, methods of cell counting, Coulter counter, automatic recognition and differential counting of cells.

Audiometer and Hearing Aids: Mechanism of hearing, measurement of sound, basic audiometer, pure-tone audiometer, speech audiometer, audiometer system, Bekesy evoked response audiometer system, calibration of audiometer and hearing aids. Patient Safety: Electric shock hazards, Leakage currents, safety codes and analyzer.

TEXT BOOK: Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003

REFERENCE BOOKS:

1. Biomedical Transducers and Instruments – by Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.

2. Biomedical Instrumentation and Measurement – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.

Subject Title	**MEDICAL PHYSICS**	**Credits**	**4**
Sub. Code	**10ML5DCMDP**	**L-T-P**	**4-0-0**

OBJECTIVE: This subject describes usefulness of physics in understanding the behavior of human body. The syllabus covers application of physics such as heat, electricity, light, sound to medicine and physics of various organ systems such as eyes lungs, heart, and circulatory system.

OUTCOME: The students will know how the human body works and the physical principles of the instruments used in medical diagnosis and therapy.

UNIT I **09 Hours**

Heat and Cold in Medicine: Physical Basis of Heat and temperature. Thermometry and Temperature Scales.Thermography-Mapping the Body's temperature.Heat therapy.Use of cold in Medicine. Cryosurgery, safety with Cryogenics

UNIT II **09 Hours**

Energy, Work and Power of the Body: Conservation of Energy in the Body, Energy changes in the body, Work and Power, Heat losses from the Body.Pressure: Measurement of Pressure in the body, Pressure inside the Skull, Eye Pressure, Pressure in Digestive system, Pressure in the skeleton, Pressure in urinary bladder, Pressure effects while Diving, Hyperbaric Oxygen Therapy (HOT)

UNIT III **10 Hours**

The Physics of the Lungs and Breathing: The Airways, How the blood and lungs interact, Measurement of Lung volumes, Pressure-Airflow-Volume relationships of the Lungs, Physics of alveoli, The breathing mechanism, Airway Resistance, Work of breathing, Physics of some common lung diseases.

UNIT IV **12 Hours**

Physics of the Cardiovascular System: major components of the Cardiovascular system. O_2 and C_{O2} exchange in the capillary system, work done by the Heart, Blood Pressure and its Measurement, Pressure across the blood vessel wall (Transmural Pressure), Bernoulli's Principal applied to the cardiovascular system. Blood Flow- Laminar and Turbulent, Heart sounds, the physics of some cardiovascular diseases.Applications of Electricity and Magnetism in Medicine: Electric shock, High frequency electricity in Medicine, Low frequency electricity and Magnetism in Medicine.

UNIT V **12 Hours**

Sound in Medicine: General properties of sound, the body as a drum, The stethoscope, Ultrasound pictures of the body, Ultrasound to measure motion, Physiological effects of Ultrasound in therapy, The production of Speech (Phonation). The structure of Ear, Sensitivity of Ear, testing your hearing deafness and Hearing aids.Light in medicine: measurement of visible Light and its units, Application of Visible light in Medicine, Application of Ultravoilet and Infrared light in Medicine, Lasers in Medicine, Application of Microscopes in Medicine. Focussing Elements of the Eye, The structure and functioning elements of the eye, Diffraction effects of the Eye, Optical illusions and related phenomena, Defective vision and its correction, Color vision and Chromatic aberration, Instruments used in Ophthalmology.

TEXT BOOK:MEDICAL PHYSICS - by John R Cameron, James G Skofronick, A Wiley-Interscience Publication.

BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

GROUP-I

ELECTIVES OFFERED

by

ELECTRICAL SCIENCE CLUSTER

(V SEMESTER)

Subject Title	Object oriented Programming using C++	Credits	4
Sub. Code	10ES5GE1OP	L-T-P	4-0-0

Objectives

- To provide basic concepts and programming practices in C++ based on Object oriented
- To equip the students with skills needed to develop any C++ applications

Outcome

The student will be geared up with the programming skills needed to meet any C++ requirements and applications

UNIT I **10 Hours**

Principles of Object oriented programming: OOP Concepts, Program construction, directives, preprocessor directives, header files and library files, Benefits and applications Beginning with C++: Definition, application, structure of C++ program, compiling and linking Tokens, expressions and control structures: Tokens, keywords, identifiers and constants, data types, symbolic constants, variables, operators, manipulators, control statements and loops.

UNIT II **10 Hours**

Functions in C++: Function prototype, argument passing, recursion, inline functions, friend and virtual functions Classes and objects: Class definition and declaration, member functions, static data members and member functions, arrays of objects, returning objects.

UNIT III **10 Hours**

Constructors and destructors: Constructors, parameterized constructors, multiple constructors in a class, copy constructor, dynamic constructors, and destructors. Operator overloading and type conversions: Overloading unary and binary operators, overloading using friends, rules for overloading.

UNIT IV **11 Hours**

Inheritance: Single and multiple inheritance, public, private and protected inheritance. Pointers, virtual functions and polymorphism. Pointers to objects, this pointer, pointers to derived classes, virtual functions. Managing console I/O operations: C++ streams, C++ stream classes, I/O operations, managing O/P with manipulators.

UNIT V **11 Hours**

Templates: Class templates, function templates, overloading template functions, member function templates and non type template arguments. Exception handling: Basics, throwing and catching mechanisms, rethrowing an exception, specifying exceptions.

TEXT BOOKS:

1. **Object oriented Programming with C++,** -E Balagurusamy (TMH Publications, 4th edn)

2. **Object oriented Programming in turbo C++,**Robert Lafore (GALGOTIA Publications)

REFERENCE BOOK:

1. **Let Us C++—**Yashavanth P. Kanetkar (BPB Publications)**Programming With C++——-**Schaum'sseries (TMH Publications)

2. **Programming With C++——-**Schaum'sseries (TMH Publications)

Subject Title	Digital System Design using VHDL	Credits	4
Sub. Code	10 ES5GE1DD	L-T-P	4-0-0

Objective: The objective of the course is to design a digital system using hardware description language (VHDL) and implementing these systems with Programmable logic devices.

UNIT I **12 Hours**

Introduction: VHDL description of combinational networks, Modeling flip-flops using VHDL, VHDL models for a multiplexer, Compilation and simulation of VHDL code, Modeling a sequential machine, Variables, Signals and constants, Arrays, VHDL operators, VHDL functions, VHDL procedures, Packages and libraries, VHDL model for a counter. Additional Topics in VHDL: Attributes, Transport and Inertial delays, Operator overloading, Multi-valued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and Text IO.

UNIT II **10 Hours**

Designing With Programmable Logic Devices: Read-only memories, Programmable logic arrays (PLAs), Programmable array logic (PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner. Designing With Programmable Gate Arrays And Complex Programmable Logic Devices: Xlinx 3000 series FPGAs, Designing with FPGAs, Xlinx 4000 series FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FELX 10K series CPLDs.

UNIT III **10 Hours**

Design of Networks For Arithmetic Operations: Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider.

UNIT IV **10 Hours**

Digital Design with SM Charts: State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines.

UNIT V **10 Hours**

VHDL Models For Memories And Buses: Static RAM, A simplified 486 bus model, Interfacing memory to a microprocessor bus. Floating-Point Arithmetic: Representation of floating-point numbers, Floating-point multiplication, Other floating-point operations.

TEXT BOOK:

Charles H. Roth. Jr:, **Digital Systems Design using VHDL**, Thomson Learning, Inc, 9th reprint, 2006.

REFERENCE BOOKS:

1. Stephen Brown & ZvonkoVranesic, **Fundamentals of Digital Logic Design** with VHDL, Tata McGrw-Hill, New Delhi, 2nd Ed., 2007
2. Mark Zwolinski, **Digital System Design with VHDL**, 2 Ed, Pearson Education., 2004
3. Volnei A Pedroni, **Digital electronics and Design with VHDL**. Elsevier

Subject Title	**Data Structures With C++**	**Credits**	**4**
Sub. Code	**10ML5GE1DS**	**L-T-P**	**3-0-1**

objective: To introduce the fundamentals of Data Structures, Abstract concepts and how these concepts are useful in problem solving. Analyze step by step and develop algorithms to solve real world problems.

Outcome: After completion of this course student will be able to understand the concepts of object oriented language such as C++. Implement various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs. Understand various searching & sorting techniques.

UNIT I **08 Hours**

C++ programming Basics: Need of object oriented programming, procedural languages, characteristics of OOP, preprocessor directives, data types, manipulators. Structures: Structures, enumerated data types, Boolean type, Functions: passing arguments, returning values, reference arguments, overloaded functions, inline functions, variable and storage classes.

UNIT II **07 Hours**

Objects and classes: objects as data types, constructors, destructors, overloaded constructors. Arrays: Arrays as class member data types, passing arrays, arrays as objects, strings, arrays of strings.

UNIT III **07 Hours**

Operator overloading: over loading of unary operators, binary operators, data conversion.**Inheritance:** Inheritance, derived class and base class, overriding member functions, scope resolution, levels of inheritance, multiple inheritances.

UNIT IV **07 Hours**

Pointers, pointers to objects, linked list, virtual functions, static functions, Working with files: Introduction, Classes for the stream operators, opening and closing files, detecting end-of-file, more about open( ); file modes, file pointers and their manipulations, sequential input and output operations, Updating a file: Random access, error handling during file operation.

UNIT V **10 Hours**

Data structures: data representation, matrices, stacks, Queues

Lab experiments Lab components must comprise of experiments that reinforce the theoretical understanding of the corresponding subject. Experiments would address concepts of Structures, Classes, Objects, Operator overloading, Inheritance, File I/O. Stacks and Queues.

TEXT BOOKS:

1. **Object oriented programming in TURBO C++**, Robert Lafore, Galgotia Publications.2002
2. **Data Structures using C++,** D.S.Malik, Thomson, 2003

REFERENCE BOOKS:

1. **Object Oriented Programming with C++**, E Balaguruswamy, Third edition, TMH2006
2. **C++ the complete reference**, Herbert Schildt, Fourth edition, TMH, 2003
3. **Data Structures, Algorithms and Applications in C++:** SartajSahni, Tata McGrawHill Publications.

Subject Title	Biomechanics	Credits	4
Sub. Code	10 ML5GE1BM	L-T-P	4-0-0

Objective: To understand and to derive the laws and principles underlying the human movement the fundamental relations between structure and function. Also to understand the measuring techniques (instruments) and the modeling theory (theory).

Outcome: Student will be able to simulate the human body joint moments for application in robotics. It helps the students apply the concepts to improve the implant design related to orthopedics. By studying the human body postures and walking style and remodeling it, the challenges to relieve pain and possibly in slow downing the progression of osteoarthritis can be achieved.

UNIT I **08 Hours**

Bio-fluid mechanics: Newton's laws, stress, strain, elasticity, Hook's-law, viscosity, Newtonian Fluid, Non-Newtonian fluid, viscoelastic fluids. Vascular tree.Relationship between diameters, velocity and pressure of blood flow, Resistance against flow.

UNIT II **12 Hours**

Flow properties of blood: physical, Chemical and Rheological properties of blood Apparent and relative viscosity. Blood viscosity variation: Effect of shear rate, hematocrit, temperature and protein contents of blood. Casson's Equation. Problems associated with extra corporeal blood flow.

UNIT III **10 Hours**

Bioviscoelastic fluid: Viscoelasticity, Viscoelastic Models: Maxwell, Voigt and Kelvin Models Response to harmonic variation. Use of viscoelastic models. Bio-Viscoelasticfluids : Protoplasm. mucus, saliva, semen, synovial fluids. Rheology of blood in microvessels: Fahreus·Lindqulst effect and inverse effect, hematocrit in very narrow tube.

UNIT IV **10 Hours**

Cardiac mechanics: Cardiovascular system. Mechanical properties of Blood vessels: arteries, arterioles, capillaries, veins, Blood flow: laminar and turbulent. Physics of cardiovascular diseases.Prosthetic heart valves and replacements. Respiratory mechanics: Alveoli mechanics, Interaction of blood and lung P-V curve of lung. Breathing mechanism.Airway resistance. Physics of lung diseases.

UNIT V **12 Hours**

Soft tissue mechanics: Pseudoelasticity, non-linear stress-strain relationship, visco elasticity. Structure, function and mechanical properties of skin, ligaments and tendons. Orthopedic mechanics: Mechanical properties of cartilage. Diffusion properties of articular, cartilage, Mechanical properties of bone.Kinetics and Kinematics of joints, Lubrication of joints.Fundamental concepts of Gait analysis.

TEXT BOOKS:

1. **Biomechanics, Mechanical properties of Living Tissues**-Y.C Fung,SpringerVerlag, Edition2, 1993.

2. **Introduction to biomechanics of joints & joint replacement mechanical Engg**-D.Dowson, V Wright 1987 publication.

3. **The biomedical Hand book**-Joseph.D.Bronzino CRC Press, 2nd Edition2, 2000.

Subject Title	**Communication Systems**	**Credits**	**4**
Sub. Code	**10EE5GE1CS**	**L-T-P**	**4-0-0**

OBJECTIVES: This course provides an understanding of communication theory as applied to the transmission of information bearing signals with equal emphasis and attention given to both analog and digital communication techniques.

OUTCOMES: Upon completion of this course,a student:

- Will have acquired the basic knowledge of communication system.
- Will have learnt to characterize and understand the need for different analog modulation schemes and their testing.
- Appreciate and understand digital communication, analog to digital conversion, sampling theorem.
- Will learn various digital modulation techniques.
- Will be provided the basic skill for understanding subjects like computer communication network, distributed computing.

UNIT I **12 Hours**

Amplitude modulation: Time-Domain Description, Frequency domain description, Generation of AM waves, Detection of AM waves, AM/DSB, Time-Domain Description, Frequency domain description Generation of DSBSC waves, Coherent Detection of DSBSC Modulated waves. Costas loop, Quadrature Carrier multiplexing, AM-SSB/SC generation, Frequency-Domain Description, Frequency discrimination method for generation an SSB Modulated wave, time domain description, phase discrimination method for generating an SSB modulated wave, Demodulation of SSB waves, Comparison of amplitude modulation techniques, frequency translation, FDM.

UNIT II **07 Hours**

Angle modulation:Basic Concepts, Frequency Modulation, Spectrum Analysis Of sinusoidal FM wave, NBFM, WBFM, Constant Average power, Transmission bandwidth of FM waves, Generation of FM waves, Direct FM, demodulation of FM waves, frequency discriminator, ZCD, phase locked loop (1st order) of AM and FM.

UNIT III **07 Hours**

Noise in Analog modulation systems: Signal-to-noise ratios, AM receiver model, Signal-to - noise ratios for coherent reception, DSBSC receiver, SSB receiver, noise in AM receivers using envelope detection, threshold effect, FM receiver model, noise in FM reception, FM threshold effect, pre-emphasis and de-emphasis in FM systems.

UNIT IV **12 Hours**

Pulse modulation : Sampling theorem for low-pass and band-pass signal, statement and proof, PAM, Channel bandwidth for a PAM signal, natural sampling, flat-top sampling, signal recovery through holding, quantization of signals, quantization error, PCM, electrical representations of binary digits, PCM systems, DPCM, delta Modulation, Adaptive delta modulation.

UNIT V **14 Hours**

Digital Modulation: Introduction, Binary Shift Keying, DPSK, QPSK, Type D flip-flop, QPSK transmitter, non-offset QPSK, QPSK receiver, signal - space representation, BFSK, spectrum, receiver for BFSK, geometrical representation of orthogonal BFSK, line codes, TDM.

TEXT BOOKS:

1. "**Analog and Digital communication**", Simon Haykin, John Wiley.

2. "**Principles of communication systems**", Taub and Schilling, Tata McGraw Hill.

REFERENCE BOOKS:

1. "**Electronic Communication Systems**", 2nd Edition, Blake, Thomson publishers.

2. "**Electronic Communication Systems**", George Kennedy.

BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

VI SEMESTER

MEDICAL ELECTRONICS

Subject Title	BIOMEDICAL DIGITAL SIGNAL PROCESSING	Credits	4
Sub. Code	10ML6DCBSP	L-T-P	3-0-1

Objectives: Understand the concepts of action potentials and its waveform for analysis. Significance and types of signal averaging methods. Understand about the filtering required for various biosignals for processing, the importance of digital and integer filters. Understand about signal processing meant for cardiological signals and neurological signals for detection of various abnormalities. Analyze algorithms based on detection and compression of signals.

Outcome: Should be able to understand and design the filters used for specific biosignal processing. To be able to understand the various measurement parameters based on signal processing concepts such as power spectral analysis on ECG, EMG, EEG signals. Time domain and frequency domain and parametric and nonparametric analysis of signals.

UNIT I **06 Hours**

Introduction to Biomedical Signals : The nature of biomedical signals, The action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis.

Signal Averaging: Basics of signal averaging, a typical signal averager, signal averaging as a digital filter.

UNIT II **08 Hours**

Filtering for removal of artifacts: Introduction, Random noise,structured noise and physiological interference, stationary versus non stationary process Adaptive filters: Principle of an adaptive filter, the steepest – Descent algorithm, adaptive noise canceller, cancellation of 60 Hz interference in electrocardiography, applications of adaptive filters. Canceling Donor-heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro-surgery.

UNIT III **09 Hours**

FIR filters: Characteristics of FIR filters, smoothingfilters, notchfilters, derivativefilters. **IIRfilters:**Generic Equation of IIR filters,simple one pole filter. **Integer Filters**:Lowpass,band pass and High pass filters. **Data Compression Techniques:**Lossy and Lossless data reduction Algorithms. ECG data Compression using Turning point, AZTEC, and Hoffman coding technique.

UNIT IV **08 Hours**

Cardiological Signal Processing: Pre-processing. ECG QRS Detection techniques.Rhythm analysis.Arrhythmia detection Algorithms.Automated ECG Analysis.ECG Pattern Recognition. Heart rate variability analysis, ST–segment analyzer, portable, arrhythmia analysismonitoring,long term continuous ECG recording.

UNIT V **08 Hours**

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination- The case of epileptic patients, overall performance.

LAB EXPERIMENTS: Read and plotting of ECG data, spectrum of ECG with 50 HZ noise,Signal Averaging to Improve the SNR for an ECG and EEG signals,Realization of IIR filters for ECG analysis, Design of FIR Filter for ECG,Integer filters for ECG,PSD estimation for ECG, EEG, and EMG. ,QRS detection and Heart rate determination,Correlation and Template matching,Realization of Notch filter for removal of line interference,Data Compression Techniques: AZTEC, TP algorithms.Note: The above experiments are to be conducted Using Matlab/ "C" language.

TEXT BOOKS:

1. Biomedical Digital Signal Processing, Willis J.Tompkins, PHI,
2. D.C.Reddy, Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill, 2005
3. Rangaraj M. Rangayyan – Biomedical Signal Analysis. IEEE Press, 2001.
4. Wavelet Transforms by Raghuveer M. Rao and Ajit S. Bopardikar, Pearson, 1998.

REFERENCE BOOKS:

1. Akay M , Biomedical Signal Processing, Academic: Press 1994
2. Cohen.A, Biomedical Signal Processing -Vol. I Time & Frequency Analysis, CRC Press, 1986.

Subject Title	**COMMUNICATION SYSTEMS**	**Credits**	**4**
Sub. Code	**10ML6DCCNS**	**L-T-P**	**3-0-1**

Objective: Electronic Communication systems can be categorized by the types of information signals transmitted by the system. There are two types of signal 'Analog and Digital'. Presently most of the communication is digital, however it is necessary to know the analog communications as real world signals are analog. From this course the Student will be able to learn both Analog & Digital Communication.

Outcome: This course deals with the methods of Modulations and demodulations and various techniques for used in both digital and analog communications. The result of this course is that one would be able to understand, design and implement communication modules which are very necessary in the present world.

UNIT I **09 Hours**

AMPLITUDE MODULATION – Introduction, time and frequency domain description, generation and detection of AM .DSBSC-time and frequency domain representation, generation and detection of DSBSC. **SSB** – time and frequency domain representation, generation and demodulation of SSB Comparison of AM techniques, application of AM in radio broadcasting.

UNIT II **08 Hours**

ANGLE MODULATION – Basic concepts ,Frequency Modulation, spectrum analysis of Sinusoidal FM wave. NBFM,WBFM, Constant average power, Transmission band width of FM waves, Generation of FM waves. Direct FM, Demodulation of FM waves, Frequency discriminator, ZCD,PLL (1^{st} order) of AM and FM.

UNIT III **07 Hours**

NOISE IN ANALOG MODULATION –Signal to noise Ratios,AM Receiver Model,Signal to Noise ratios for Coherent Reception.,DSBSC receiver, SSB receivers, threshold effect, noise in FM receiver, FM threshold. Noise in FM Reception ,Pre-emphasis and De-Emphasis in FM.

UNIT IV **08 Hours**

PULSE MODULATION: Sampling theorem for low pass and band pass signal, statement and proof,PAM,Channel bandwidth for a PAM signal. Natural sampling ,Flat –Top sampling, Signal recovery through Holding, Quantization of signals, Quantization error,PCM,Electrical representations of Binary digits, The PCM systems, DPCM, Delta Modulation, ADM.

UNIT V **07 Hours**

DIGITAL MODULATION: Introduction,Binary shift keying,DPSK,QPSK, Type D Flip – Flop,QPSKTransmitter,Non-offset QPSK,QPSK receiver.

LAB EXPERIMENTS: Amplitude Modulation: Collector modulation, Frequency Modulation- Using IC 8038. Demodulation of AM, Mixers, Analog Multiplexer - FDM TDM.-using IC'S, Digital Modulation- Generation & Recovery of ASK, FSK, BPSK, Digital Modulation- Generation & Recovery of PAM, PWM, Frequency Demodulator -Using Phase Locked Loop IC.

TEXT BOOKS:

1. An introduction to analog and digital communication - Simon Haykin

2. Communication systems – Simon Haykin, John Wiley & Sons.

REFERENCE BOOKS:

1. Communication Systems –Harold. P.E, Stern Samy. A. Mahmond, Pearson Education, 2004

2. Communication Systems –A.Bruce Carlson, Paul B Crilly, Janet.CRuteledge, 4e, McGraw-Hill

3. Principle of Communication – Rodger, E. Ziemer, William H. Tranter

Subject Title	BIOMEDICAL EQUIPMENTS	Credits	4
Sub. Code	10ML6DCBME	L-T-P	3-0-1

Objective: Understand the need & advantages cardiac pacemakers and its types, the significance of fibrillators and defibrillators. Understand about the knowledge of surgerical instruments used for specific applications. Understand about the concept of dialysis and measurement involved. Understand about the need of physiotherapic and electrotherapic instrument and the use of anesthesia in various clinical applications.

Outcome: Should be able to know the fundamentals of bioequipments used. It helps for students to involve in hospital training visits for understanding of handling of Major biomedical equipments for specific applications. To be able to understand the instrumentation of the equipments used.

UNIT I **09 Hours**

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker, External Pacemaker, Implantable pacemaker, Types of Implantable pacemakers and recent developments Programmable pacemaker, Rate-responsive pacemakers, pacing system Analysers, Need for Defibrillator, Dc defibrillators, Implantable Defibrillators, pacer- cardioverter-defibrillator analysers, Defibrillator analysers

UNIT II **08 Hours**

Instruments of Surgery: Principles of surgical diathermy, surgical diathermy Machine, safety aspects in electro- surgical units, surgical diathermy Analyzer. Automated Drug Delivery Systems: Infusion pumps, components of drug infusion systems and implantable infusion systems, closed loop control in infusion systems and examples.

UNIT III **08 Hours**

Haemodialysis Machine: Function of kidney, artificial kidney, dialyzer, Membranes for haemodialysis, portable kidney machine. Lithotripsy: Stone disease problems, lithotripter machine, extra-corporeal Shock wave therapy. Modern lithotripter systems.

UNIT VI **07 Hours**

Physiotherapy and Electrotherapy Equipments: High frequency heat therapy, Short-wave diathermy, microwave diathermy, ultrasound therapy unit, Electro diagnostic therapeutic apparatus, pain relief through electrical Stimulation, bladder and cerebella stimulators.

UNIT V **07 Hours**

Anesthesia Machine**:** Need for anesthesia, anesthesia Machine, electronics in the anesthetic machine. Ventilators: Mechanics of respiration, artificial ventilation, ventilators, types of ventilators, ventilator terms, classification of ventilators, pressure volume flow diagrams, modern ventilators, high frequency ventilators, humidifiers, nebulizers and aspirators.

Hospital Training

TEXT BOOK: Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.

REFERENCE BOOK: Biomedical Instrumentation and Measurement – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd.

Subject Title	**DIGITAL IMAGE PROCESSING**	**Credits**	**5**
Sub. Code	**10ML6DCDIP**	**L-T-P**	**4-0-1**

OBJECTIVE: Cover the basic theory and algorithms that are widely used in digital image processing. - Expose students to current technologies and issues that are specific to image processing systems

OUTCOME: Develop hands-on experience in using computers to process imagesFamiliarize with MATLAB Image Processing Toolbox. Develop critical thinking about shortcomings of the state of the art in image processing

UNIT I **10 Hours**

Fundamentals: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing fundamentals related with all color Models

UNIT II **12 Hours**

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing– Histogram equalization, Histogram matching (specification), Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial filters – Smoothinglinear filters, order statistics filters Sharpeningspatial filters – Foundation,TheLaplacian, The Gradient.

UNIT III **08 Hours**

Image Enhancement in Frequency Domain: Background, Basic properties of the frequencydomain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal lowpass filters, Butterworth lowpass filters, Gaussian lowpassfilters, Sharpening frequency domain filters – Ideal highpass filters, Butterworth highpassfilters, Gaussian highpass filters, Homomorphic filtering.

UNIT IV **10 Hours**

Image Restoration: Image degradation/restoration model, Noise models, Restoration using spatial filtering – Mean filters, Geometric mean filters, Harmonic mean filters, Median filter, Max & min filters, Midpoint filter.

Noise filtering by frequency domain filtering– Band reject filters, Band pass filters, Notch filters, Inverse filtering, Minimum mean square error (Wiener) filtering.

UNIT V **12 Hours**

Image Compression: Fundamentals, Variable length coding, LZW coding, Bit plane coding, Constant area coding, Run length coding, Lossless predictive coding, Lossy predictive coding, Transform coding, Image compression standards – Basic, JPEG.

Image Segmentation: Introduction, Thresholding: Threshold detection methods,Optimalthresholding, Multi-spectral thresholding, Edge-based segmentation: Edge image thresholding, Border tracing, Hough transform, Region-based segmentation –Region merging, Region splitting, Splitting & merging. Matching, Matching criteria.

LAB EXPERIMENTS: Simulation and display of an image and its negative (Binary & Gray scale), relationship between pixels, transformation of image, Image enhancement techniques, Bit planes, Computation of Mean SD and Correlation Coefficient. Image smoothing and sharpening filters, Edge detection with gradient filters, image restorartion, intensity slicing and segmentation.

TEXT BOOK:Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, Third Edition. Pearson Education Inc.

REFERENCE BOOKS:

1. **Digital Image Processing** by RafaelC. Gonzalez & Richard E. Woods, First Edition. Pearson Education Inc.
2. **Fundamentals of Digital Image Processing** by Anil K. Jain. Prentice Hallof India.
3. **Image Processing, Analysis andMachine**-Vision by Milan Sonka, Vaclav Hlavac& Roger Boyle, Second Edition

BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

GROUP-II

ELECTIVES OFFERED

by

ELECTRICAL SCIENCE CLUSTER

(VI SEMESTER)

Subject Title	Fundamentals of VLSI	Credits	4
Sub. Code	10EE6GE2FV	L-T-P	4-0-0

ObjectiveUse of VLSI technology has increased in recent past. With the advent of power semiconductor devices, most of the large circuits have been replaced by small and compact VLSI circuits.

OutcomeThis subject helps the students to build up their own circuits using VLSI system design. They can further learn advance VLSI. Mini projects may be carried out. Lot of scope is there for creativity and research in this field.

UNIT I **06 Hours**

A Review of Microelectronics and an Introduction To Mos Technology: Introduction to integrated circuit technology, Production of E-beam masks. Introduction, VLSI technologies, MOS transistors, fabrication, thermal aspects, production of E-beam masks.

UNIT II **10 Hours**

Basic Electrical Properties of Mos an Bicmos Circuit: Drain to source current Ids versus Vds relationships-BICMOS latch up susceptibility. MOS transistor characteristics, figure of merit, pass transistor NMOS and COMS inverters, circuit model, latch up.

UNIT III **08 Hours**

Mos And Bicmos Circuit Design Processes: Mass layers, stick diagrams, design, symbolic diagrams.

UNIT IV **16 Hours**

A) Basic Circuit Concepts: Sheet resistance, capacitance layer inverter delays, wiring capacitance, choice of layers.

B) **Scaling OfMos Circuits**: Scaling model and scaling factors- Limit due to current density.

UNIT V **12 Hours**

Subsystem Design And Layout , Subsystem Design Processes : Some architecture issues-other systems considerations. Examples of structural design, clocked sequential circuits . Some general considerations, an Illustration of design process, observations.

TEXT BOOKS:"**Basic VLSI Design**" -3rd Edition, Pucknell Douglas Al , PHI

REFERENCE BOOKS:

1. "**Fundamentals of Modern VLSI Devices**"-Yuan TaunTak H Ning Cambridge Press, South Asia Edition 2003,
2. "**ModernVLSI Design Wayne wolf**", Pearson Education Inc. 3rd edition"-Wayne Wolf 2003.

Subject Title	**Utilization of Electrical Power**	**Credits**	**4**
Sub. Code	**10EE6GE2UP**	**L-T-P**	**4-0-0**

Objective:

- To understand the fundamentals of illumination and its classification and the electric heating and welding.
- To study Electric traction systems in detail and their practical applications.

Outcome:

- At the end of the course, the students will understand the principles of electric heating and welding and apply the same for practical applications.
- Students will understand the practical functioning of Electric Traction Systems (eg. Electric Railways)

UNIT I **12 Hours**

Heating and welding: Advantages and methods of electric of heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building, electric welding, resistance and arc welding, control device and welding equipment.

UNIT II **08 Hours**

Electrolytic process: Fundamental principles, extraction, refining of metals, electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

UNIT III **08 Hours**

Illumination: Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps, incandescent, fluorescent, vapor and CFL and their working.

UNIT IV **12 Hours**

Introduction to Electric traction: Systems of traction, speed time curve, tractive effort, co-efficient of adhesions, specific energy, factors affecting specific energy consumption, selection of traction motors.

UNIT V **12 Hours**

Control of Traction Motors: Methods of speed control, energy saving by series parallel control. AC series motor, characteristics, regenerative braking, linear induction motor and their use.Diesel electric equipment, train lighting system.

TEXT BOOKS:

1. J.B.Gupta, **Utilization of Electric Power and Electric Traction**, S.K Kataria and Sons

2. Chakraborthy, SoniGupta&Bhatnagar, **A Course in Electrical Power**, DhanpatRai and Sons

REFERENCE BOOK: Openshaw Taylor, **Utilization of electric energy**, Orient Longman

Subject Title	Operating Systems Concepts	Credits	4
Sub. Code	10TC6GE2OS	L-T-P	4-0-0

OBJECTIVE:

The objective of the subject is to introduce the students to the basic concepts of operating system, structure of an operating system and design overview & different types OS etc. The course emphasizes the need for learning various concepts related to the nature of applications such as real time application need real time operating system.

UNIT I **10 Hours**

Introduction: What operating systems do, Computer system architecture, Operating system structure, Operating system operations, Process management, Memory management, Storage management, Protection and Security, Distributed systems.System Structures: Operating system services, User operating system interface, System calls, Type of system calls, System programs, Operating system design and implementation, Operating system structure, Virtual machines

UNIT II **10 Hours**

PROCESS MANAGEMENT Process Concept: Overview, Process scheduling, Operation on process, Interprocess communication, Communication in client server systems, Process scheduling: Basic concept, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling, Operating system examples, Algorithm evaluation

UNIT III **12 Hours**

MEMORY MANAGEMENT: Background, swapping, Contiguous memory allocation, Paging, Structure of the page table, Segmentation, example: The intel pentium VIRTUAL MEMORY: Background, Demand paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory Mapped Files, Allocating kernel memory, Other considerations.

UNIT IV **10 Hours**

FILE SYSTEMS: File concept, Access methods, Directory structure, File system mounting, File sharing, Protection.IMPLEMENTING FILE SYSTEMS: File system structure, File system implementation, Directory implementation, Allocation methods, Free space management, Efficiency and Performance, Log structure file systems, overview of mass storage structure, Disk structure, Disk attachment, Disk scheduling

UNIT V **10 Hours**

SYSTEM PROTECTION: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access Control, Revocation of access rightsREAL TIME SYSTEMS: Overview, System characteristics, Features of real time kernels, Implementing real time operating systems, Real time CPU scheduling, VxWorks 5.xMULTIMEDIA SYSTEMS: what is multimedia, Compression, Requirement of multimedia kernels, CPU scheduling, Disk scheduling, Network management, Example CineBlitz

TEXT BOOK:

Operating Systems Concepts, Silberschatz and Galvin, John Wiley, 7th Edition, 2001.

REFERENCE BOOKS:

1. "**Operating Systems - A Concept based Approach**", D. M. Dhamdhare, TMH, 2nd Ed, 2006.

2. **Operating System – Internals and Design Systems**, Willaim Stalling, Pearson Education, 4th Ed, 2006.

Subject Title	Introduction to Image Processing	Credits	4
Sub. Code	10TC6GE2IP	L-T-P	3-0-1

OBJECTIVE:

The objective of the subject is to introduce the students to the basic concepts and analytical methods of image processing and also use of modern image processing tools viz. MATLAB, LABVIEW etc. The application of image processing is vast covering the areas of medical field, military, satellites, entertainment etc. The course emphasizes the need for learning various algorithms related to image processing and applying them in practical environment.

UNIT I **07 Hours**

Fundamentals of image processing: Introduction, Fundamental steps in DIP, Components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels.

UNIT II **08 Hours**

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Local enhancement.

UNIT III **08 Hours**

Image Enhancement in Frequency Domain: Background, Basic properties of the frequency domain, Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters – Ideal lowpass filters, Butterworth lowpass filters, Gaussian lowpass filters, Sharpening frequency domain filters – Ideal highpass filters, Butterworth highpass filters, Gaussian highpass filters, Homomorphic filtering.

UNIT IV **08 Hours**

Image Restoration: Image degradation/restoration model, Noise models, Restoration using spatial filtering – Mean filters, Geometric mean filters, Harmonic mean filters, Median filter, Max & min filters, Midpoint filter, Wiener filter, constrained least squared filter.

UNIT V **08 Hours**

Color image transforms: Fundamentals of color image processing, Color models, Conversion of color models from one form to other form.

Basic image transforms: Two-dimensional orthogonal unitary transforms, Properties of Unitary Transforms, Introduction to Wavelet Transforms.

Lab Experiments: Lab experiments to be conducted on image enhancement techniques, histogram equalization, filtering operations on images, arithmetic and logical operations on images, contrast stretching.

TEXT BOOK:

Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, Third Edition. Pearson Education.

REFERENCE BOOKS:

1. **Digital Image Processing** by Rafael C. Gonzalez & Richard E. Woods, First Edition. Pearson Education Inc.
2. **Digital Image Processing** by S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw hill, 2009

Subject Title	Biosensors	Credits	4
Sub. Code	10ML6GE2SN	L-T-P	4-0-0

Objective Understanding the components used for various biosensors and biosensor family. Principles and types of transducers. Helps to Know about the applications on clinical chemistry, healthcare and veterinary and agriculture, the usage of biosensors on environmental samples and application on Biochips and geonomics. Understanding the principles of semiconductor electrodes used for preparation of biosensors and its different types and different photometric assay techniques.

Outcome: Based on the concepts of biosensors and its types and techniques the biomedical applications can be applied in health care industry and more clinical laboratories. It helps in devising applications in clinical chemistry, veterinary applications and molecular electronics as applied to biomedical field

UNIT I **10 Hours**

Introduction: Introduction to Biosensors. Advantages and limitations, various components of biosensors, the growing of biosensor.The biosensor family, the biomolecule ingredients, proteins, enzymes complexes, enzymes kinetics, the proteins of the immune systems.

UNIT II **10 Hours**

Transducers in biosensors: Various types of transducers, principles and applications - Calorimetric, optical, potentiometric / amperometric, conductrometric/resistormetric, piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminescences - based biosensors.

UNIT III **10 Hours**

Application and uses of biosensors: Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food. Biosensors for personal diabetes management, application of biosensors to environmental samples. Biochips and their application to genomics.

UNIT IV **12 Hours**

Semiconductor electrodes: Measurement of H^+ , Ion selective interfaces, Ion selective electrodes, semiconductor electrodes, MIS structures, semiconductor solution interface, FET, chemical sensitive FETA (CHEMFETA), suspended gate field effect transistor, selectivity via pattern recognition, Ion selective FET (ISFET), reference FET, CHEMFET, assessment of CHEMFETS.

UNIT V **10 Hours**

Photometric assay techniques: Energy transition, ultraviolet and visible absorption spectra, fluorescence and phosphorescence, infra Red transitions, light scattering, Raman scattering, applications of ultraviolet visible spectra, indicator linked bioassay, irrational spectroscopy, the optical transducer, wave guides in sensors, device construction, PH optical probes, light scattering analysis.

TEXT BOOKS:

1. **Biosensors** by Elizabeth A. Hall - Open University press, Milton Keynes.
2. **Commercial Biosensors** by Graham Ramsay, John Wiley and son, INC. (1998).

REFERENCE BOOKS:

1. **Biosensors** by Eggins
2. **Biosensors** edited by AEG CASS – OIRL press, Oxford University.
3. **Transducers and Instrumentation** by Murthy D V S. Prentice Hall, 1995

Subject Title	Biostatistics	Credits	4
Sub. Code	10ML6GE2BS	L-T-P	4-0-0

Objective: To Analyze Statistical Data and to infer efficient decision by applying various statistical method in the Medical Field. In this course, one will be able to calculate statistics and do decisions based on the results of statistics. Also one would be able to find the best statistics method to apply and come up with efficient decision.**Outcome:** The student will be able to arrive at conclusions drawn from statistical analysis for Medical Data which would be helpful for the doctors and Medical practitioner for effective diagnosis and treatment.

UNIT I **10 Hours**

Introduction to Biostatistics: Introduction, Some basic concepts, measurement and Measurement Scales, Simple random sample, Computers and biostatistical analysis. Descriptive Statistics: Introduction, ordered array, grouped data-frequency distribution, descriptive statistics- measure of central tendancy, measure of dispersion, measure of central tendancy computed from grouped data, variance and standard deviation-grouped data.

UNIT II **10 Hours**

Basic probability Concepts: Introduction, two views of probability – Objective and Subjective, Elementary properties of Probability, calculating the probability of an event.

Probability distribution: Introduction, probability distribution of discrete variables, binomial distribution, Poisson distribution, continuous probability distribution, normal distribution and applications.

Sampling distribution: Introduction, sampling distribution, distribution of the sample mean, distribution of the difference between two sample means, distribution of the sample proportion, distribution of the difference between two sample proportions.

UNIT III **10 Hours**

Estimation: Introduction, Confidence interval for population mean, t-distribution, Confidence interval for difference between two population means, Population proportion and difference between

two population proportions, determination of sample size for estimating means, estimating proportions, confidence interval for the variance of normally distributed population and ratio of the variances of two normally distributed populations.

UNIT IV **10 Hours**

Hypothesis Testing: Introduction, hypothesis testing – Single population mean, difference between two population means, paired comparisons, hypothesis testing – single population proportions, single population variance, ratio of two population variance.Analysis of variance (ANOVA) – Introduction, completely randomized design, randomized completer block design, factorial experiment.

UNIT V **12 Hours**

Linear Regression and Correlation: Introduction, regression model sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient. Multiple Regression and Chi-square Distribution: Multiple linear regression model, obtaining multiple regression equation, evaluating multiple regression equation, Using the multiple regression equation, Multiple correlation model, mathematical properties of Chi-square distribution, tests of goodness of fit, tests of independence, tests of homogeneity.

TEXT BOOK:

BIOSTATISTICS-A Foundation for analysis in the Health Sciences by Warne W Daniel, John Wiley & Sons Publication, 6th Edition.

REFERENCE BOOKS:

1. **Principles of Biostatistics** – by Marcello Pagano and KimberleeGauvreu, Thomson Learning Publication, 2006

2. **Introduction to Biostatistics** – by Ronald N Forthofer and EunSul Lee, Academic Press.

3. **Basic Biostatisitcs and its Applications** – by Animesh K Dutta 2006.

Subject Title	Advanced Microcontrollers & Applications	Credits	4
Sub. Code	10EC6GE2MC	L-T-P	3-0-1

Objective:

- To provide basic concepts of a RISC Machine(ARM) Processor
- Understand architecture, instruction set and programming both in ARM and Thumb mode
- Understand the various aspects embedded C programming and embedded system protocols

Outcome

Students will be able to write the program in assembly language and execute on ARM9 platform with embedded operating system for interfacing applications like GPIO, PWM, Seven-segment display, UART ,LCD

UNIT I **08 Hours**

Migration from 8051 to 32bit cores, RISC design and ARM Design Approach, Advantages of ARM, ARM processor Fundamentals, Registers, Current Program Status Registers,3 stage and 5 Stage Pipeline, Exceptions ,Interrupts and Vector Table, Processor Families and Co processor Interface.

UNIT II **08 Hours**

ARM Instruction Sets, Data Processing Instructions, Branch Instructions, Load Store Software Interrupt, Program Status Register Instructions, ARM Organization & Implementation,) Thumb Instruction Sets, Thumb Register Usage, ARM-Thumb Inter-working, Cross compilers and Optimization, Overview of C compilers and Optimization, Basic C data types, C looping Structures, Function calls, Pointer Aliasing, Structure Alignment, Portability Issues, Examples & exercise.

UNIT III **08 Hours**

Writing and Optimizing ARM Assembly Code, Writing Assembly Code, Instruction Scheduling, Register Allocation, Looping Constructs, Bit Manipulation, Examples & exercise.

UNIT IV **08 Hours**

Firmware and Bootloader, Embedded Operating Systems, Memory Management Unit Working With I2C ,SPI and USB protocols, Examples and Exercises

UNIT V **07 Hours**

Future of the Architecture, Future Trends in Embedded Industry -Existing cores -MIPS ,Intel ATOM. Embedded ARM applications- VLSI Ruby II Advanced Communication Processors, The One CTMVWS22100 GSM Chip, the AMULET Asynchronous ARM Processors- Self- timed design

LAB EXPERIMENTS Simple assembly language program: Running LEDs, Interfacing a 7 segment display and working, Using GPIOs on Expansion ports, Write serial communication program in C, Interfacing a TFT display, Interfacing and running PWM drive, Video Guide for porting Linux Kernel and working with Display drivers, Configuring and working with USB device Port, Configuring and working with Audio Codec

TEXT BOOKS:

1. **ARM System-On-Chip Architecture** By Steve Furber, Addison Wesley, Pearson Education, 2nd edition
2. **ARM System** Developer's Guide By Andrew N Sloss
3. **Experiments on ARM 9** –Practical Guide ,Book By Innovate Software Solutions Pvt Ltd

REFERENCE BOOKS:

1. **agger (Ed) ARM architectural reference manual**, Prentice Hall
2. **ARM assembly language an introduction** by J. R. Gibson
3. **ARM – Architecture, Programming and Development Tools** by Raj Kamal, from Pearson Education, 2005.

Subject Title	DSP Architecture and Systems	Credits	4
Sub. Code	10EC6GE2DA	L-T-P	4-0-0

Objectives

- To introduce concepts of Digital signal processing
- Provide Architectural and programming concepts of Texas TMS32054xx processor.
- Implementation of DSP algorithms and Interfacing of DSP to the external peripherals

Outcome

Students will be able to Implement DSP algorithms used in real time applications exploiting the futures of DSP processors

UNIT I **10 Hours**

Architectures for Programmable Digital Signal-Processors: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.

UNIT II **12 Hours**

Programmable Digital Signal Processors: Introduction, Data Addressing Modes of TMS32OC54xx Digital Signal Processors, Data Addressing Modes of TMS32OC54xx Processors, Program Control, Detail Study of TMS320C54X & 54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor.

UNIT III **10 Hours**

Implementation of Basic DSP Algorithms: Introduction, The Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case).**Implementation of FFT Algorithms**: Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit-Reversed Index Generation & Implementation on the TMS32OC54xx.

UNIT IV **10 Hours**

Interfacing Memory and Parallel I/O Peripherals to DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Intface, Parallel I/O Interface, Programmed I/O, Interrupts and I / O Direct Memory Access (DMA).

UNIT V **10 Hours**

Interfacing And Applications of DSP Processor: Introduction, Synchronous Serial Interface, A CODEC Interface Circuit. DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System.

TEXT BOOK:

"**Digital Signal Processing**", Avatar Singh and S. Srinivasan, Thomson Learning, 2004.

REFERENCE BOOKS:

1. **Digital Signal Processing**: **A practical approach,** Ifeachor E. C., Jervis B. W Pearson-Education, PHI/ 2002
2. "**Digital Signal Processors**", B Venkataramani and M Bhaskar TMH, 2002
3. "**Architectures for Digital Signal Processing**", Peter Pirsch JohnWeily, 2007

Subject Title	**Biomedical DSP**	**Credits**	**4**
Sub. Code	**10IT6GE2MD**	**L-T-P**	**3-0-1**

Objective:

Examining the full scope of digital signal processing in the biomedical field, this course provides the basics of digital signal processing as well as programming in MATLAB for designing and implementing digital filers for biomedical application. It provides a set of laboratory experiments that can be done using either an actual analog-to-digital converter , or taking the available data base to process the biomedical signals. The course emphasizes on feature extraction and classification of normal and abnormal features using different modeling techniques.

UNIT I **10 Hours**

INTRODUCTION TO BIOMEDICAL SIGNALS: The nature of biomedical signals, the action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis. Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, The use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording, Neurological Signal Analysis The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis.

UNIT II **9 Hours**

Cardiological Signal Processing: Adaptive Interference/Noise Cancellation, A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest-descent algorithm, the Widrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 60Hz interference in ECG, Canceling Donor-heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro-surgery.

UNIT III **06 Hours**

ECG Data Reduction Techniques Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Transformation compression techniques, other data compression techniques, Data compression techniques comparison.

UNIT IV **06 Hours**

LINEAR PREDICTION THEORY The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination-the case of epileptic patients, overall performance.Sleep EEG. Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, Event history analysis for modeling sleep.

UNIT V **08 Hours**

Prony's Method: Exponential modeling, Exponential parameter estimation, The original Prony problem, Least squares prony method, The covariance method of linear prediction, Prony's method in the presence of noise, clinical application of prony's method.

Simulations EXPERIMENTS USING matlab on :FIR filter DEsign, iir filter design , implementing Pan tompkinsalgorithm,adaptive filters for cancelling different noise in ecg, ar prediction , time frequency analysis using wavelet transforms, ADAPTIVE WAVELETS FOR DENOISING.

TEXT BOOKS:

1. "**Biomedical Signal Processing Principles and Techniques**", by D C Reddy, The McGraw-Hill publications.
2. "**Biomedical Signal Analysis a case study approaches**", by Rangaraj M. RangayyanThe John Wiley publications

REFERENCE BOOK:

"**Biomedical Digital Signal Processing**", Willis J. Tompkins, The Prentice Hall of India publications.

Question Paper Pattern: Internal Choice in **Unit 3** and **Unit 5**

BMS COLLEGE OF ENGINEERING, BANGALORE
(Autonomous College under VTU)

GROUP-III

ELECTIVES OFFERED

by

ELECTRICAL SCIENCE CLUSTER

(VI SEMESTER)

Subject Title	Embedded System Design	Credits	4
Sub. Code	10EE6GE3ED	L-T-P	4-0-0

Objectives:

- Create an environment for the systematic and effective application of scientific principles to the efficient design and operation of computer-based structures, processes and systems.
- Create a setting where students can identify deficiencies or weaknesses in an existing solution and try novel ideas to improve it.
- Indulge the concept where the task of design is fundamental and central.
- Prepare educational materials that have a great deal of content, while at same time teaching students to think and discover for themselves.
- Further enhancement of this subject for students will be in the field of Robotics, navigation, missile, satellite launching, wireless communication, instrumentation controls and defense applications from which students are benefitted to the greater extent and they will be convinced that this subject plays a vital role for the future scope.

Outcomes:

- To possess the ability to design computers and computer based systems that include both hardware and software to solve novel engineering problems, subject to trade-offs involving a set of competing goals and constraints.
- To be able to use their breadth of knowledge in engineering sciences that are associated with the broader scope of engineering and apply it to the narrow field of computer-based systems design.

UNIT I **12 Hours**

Concept of embedded system design: Internal Block Diagram, Components, classification, skills required. Embedded Micro controller cores: Features, Architecture and block diagram of Motorola Controller (6808 or 6811).Embedded Memories ROM variants, RAM, Applications of **embedded system**: Examples of Embedded systems, SOC for cellular phones, Smart cards, etc.

UNIT II **09 Hours**

Technical aspects of Embedded System: Interfacing between analog and digital blocks, Signal conditioning, digital signal processing, DAC & ADC interfacing, various signal conditioning circuits using DSP or Motorola Controller.

UNIT III **10 Hours**

Interfacing Concepts: Sample & hold, multiplexer interface, Internal ADC interfacing with DSP or Motorola Controller, Data Acquisition System and Signal processing circuits, criteria in the selection of embedded system design, Design challenge, design technology, Software aspects of Embedded Systems.

UNIT IV **11 Hours**

Software Design: Real time programming Languages, operating systems. Programming concepts and embedded programming in C, Scheduling algorithms such as Round Robin, Round Robin with interrupts, priority, pre-emptive, function queue-scheduling architecture, Real time OS architecture, and selection.

UNIT V **10 Hours**

Peripheral Interfacing: Introduction to RTOS, Subsystem interfacing with external systems such as, Serial I/O devices, Parallel port interfaces, Input switches, Key boards and Memory interfacing. 10 Hours

TEXT BOOKS:

1. "**Embedded Microcomputer systems**: Real time interfacing"- Valvano, J.W, Brooks/ Cole, 2000

2. "**Embedded System, Architecture, Programming and Design**"- Raj Kamal TMH 2003.

REFERENCE BOOKS:

1. "**A Unified Hardware/Software Introduction**"-Frank Vahid/Tony Givargis, Wiley student edition 2002 .

2. Jane W.S., Liu, "**Real time systems**", Pearson Education Asia Pub, 2004.

3. Motorola and Intel Manuals

Subject Title	ELECTRICAL MACHINE DESIGN & DRAWING	Credits	4
Sub. Code	11EE6GE3MD	L-T-P	3-0-1

Objective

- To study the design of Electrical Machines as per ISI specifications emphasizing on the materials used along with the design of motors.
- To prepare the design drawings using AUTOCAD software.

UNIT I **07 Hours**

Principles of Electrical Machine Design:Introduction, considerations for the design of electrical machines, design factors, limitations, different types of materials & insulators used in electrical machines.

UNIT II **08 Hours**

Design of transformers (Single phase and three phase): Output equation for single phase and three phase transformer, choice of specific loadings, expression for volts/turn, determination of main dimensions of the core, estimation of number of turns and cross sectional area of Primary and secondary coil, estimation of no load current.

UNIT III **08 Hours**

Design of DC Machines: Output equation, choice of specific loadings and choice of number of poles, design of Main dimensions of the DC machines, Design of armature slot dimensions, commutators and brushes**. In**troduction, types of motors, output equation, choice of specific loadings.

UNIT IV **08 Hours**

Design of Three Phase Induction Motor: Output equation, choice of specific loadings, main dimensions of three phase induction motor, stator winding design, choice of length of the air gap, General methodology of rotor design, design of slip ring induction motor, Estimation of no load current of Induction motor.

UNIT V **08 Hours**

Design of Synchronous Machines: Output equation, choice of specific loadings, short circuit ratio, Design of main dimensions, armature slots and windings, slot details for the stator of salient and non salient pole synchronous machine, dimensions of the pole body.

COMPUTER AIDED ELECTRICAL DRAWING

1. Study of CAD graphics package
2. Exercises on Computer aided Electrical drawing
   a) Computer Aided Drawing of Single line diagram of a typical substation
   b) Computer aided drawing of simplex single layer lap and weave DC and AC armature windings
   c) Computer aided drawing of half sectional views of single phase core and shell type transformer
   d) Simple sectional views of alternators and induction motors of different types

TEXT BOOKS:

1. A.K.Sawhney, A course in electrical machine design, Dhanpat Rai & Sons
2. V.N.Mittle, Design of electrical Machines, 4/e edition, Standard Publishers.

REFERENCE BOOKS:

1. M.G.Say, Performance & Design of AC Machines.
2. R.K.Aggarwal, Principles of Electrical Machine Design.

Subject Title	Electronic Instrumentation	Credits	4
Sub. Code	10EE6GE3EI	L-T-P	4-0-0

Objective

The measuring instruments play an important role for any circuit applications. The various types of electrical/mechanical measurements can be done using voltmeters, recorders, transducers, phase meters etc. The subject gives a detail study of various types of measurements needed and the type of instruments needed for the same. This would be useful to students to enhance their knowledge in this field.

Outcome

All types of measuring instruments are commonly used by all. It would benefit the students by having the knowledge of frequently used measuring instruments. The circuits are simple and can be built up in the laboratory itself. This would help them to have a very good practical exposure.

UNIT I **11 Hours**

Electric instruments for measuring basic parameters: Introduction, amplified DC meter, AC voltmeter using rectifiers, electronic multi meter, considerations in choosing an analog voltmeter, Q meter.

UNIT II **10 Hours**

Strip Chart Recorders, Galvanometer type, Null type, X-Y recorders Standard Signal Generator, AF sine and square wave generator, function generator, square and pulse generator .(block diagram description)

UNIT III **11 Hours**

Transducers: classification of transducers, selecting a transducer, potentiometric transducer, LVDT, strain gauges types, Piezo electric transducers, problems.

UNIT IV **10 Hours**

Field Strength Meter, Stroboscope Phase meter, Direct reading Impedance meter, LC bridge, R-X meter

UNIT V **10 Hours**

Instrumentation Systems, interfacing transducers to electronic control and measuring systems, multiplexing.

TEXT BOOKS:

1. **Modern Electronic Instrumentation and Measurement Techniques**, Albert.D.Helfrick, William.D.Cooper, 3/e Pearson, PHI.
2. **Electronic Instrumentation**, H.S. Kalsi, TMH.

REFERENCE BOOK:

A course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, 18th Edition, DhanpatRai and Co., New Delhi.

Subject Title	**Renewable Energy Resources**	**Credits**	**4**
Sub. Code	**10EE6GE3RE**	**L-T-P**	**4-0-0**

UNIT I **[13 hours]**

Introduction to energy sources, need for non-conventional energy sources

SOLAR ENERGY: Introduction, extra terrestrial and terrestrial solar radiation, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems); Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer.

SOLAR- ELECTRIC CONVERSION SYSTEM: solar energy collection ,thermal energy transfer, thermal energy storage, energy conversion Solar Thermal Systems: Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green Houses.

UNIT II **07 Hours**

Solar Electric Systems: Solar Thermal Electric Power Generation – Solar Pond and Concentrating Solar Collector (parabolic trough, parabolic dish, Central Tower Collector). Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Photo-voltaic energy storage, Solar PV Systems – stand-alone and grid connected; Applications – Street lighting, Domestic lighting and Solar Water pumping systems. Central receiver systems, the Heliostats, satellite solar power systems.

UNIT III **09 Hours**

Wind energy: Introduction, principles of wind power, wind turbine operation, site characteristics, variation of power output with wind speed, new developments: small machines, large machines.

UNIT IV **12 Hours**

Energy from oceans: Introduction, ocean temperature differences, the open or Claude cycle, modification of the open OTEC cycle, the closed or Anderson cycle, OTEC cycle, ocean waves, wave motion, energy and power from waves, wave-energy conversion by floats, high pressure accumulation wave machines, the tides, the simple single-pool tidal system, the modified single-pool tidal system, the two-pool tidal system biofouling, Advantages &Limitation of OTEC.

GEOTHERMAL ENERGY: Introduction, origin and types of geothermal energy, operational and environmental problems, vapor dominated systems, liquid dominated systems, (flashed steam, binary cycle, total flow concept)

UNIT V **11 Hours**

Energy storage: Energy storage systems, pumped hydro, compressed air storage, energystorage by (i) flywheels (ii) electrical battery (iii) super conducting magnet, (iv) latent heat (v)chemical reaction (vi) thermal sensing.

Emerging Technologies: Fuel Cell, Small Hydro Resources, Magneto Hydro Dynamic Generation, Hydrogen Energy, (Principle of Energy generation using block diagrams, advantages and limitations).

TEXT BOOK:

"**Non-Conventional Sources of Energy**"- 4th Edition, G.D.Rai, Khanna Publishers, New Delhi, 2007

REFERENCE BOOKS:

1. "**Generation of electrical Energy**"-B.R.Gupta-S.Chand& Company Ltd

2. "**Non-Conventional Energy Resources**"- Khan, B. H., TMH, New Delhi, 2006.

Subject Title	Real Time Embedded Systems	Credits	4
Sub. Code	10TC6GE3RT	L-T-P	4-0-0

Objective

The objective of the subject is to introduce the students to the world of Real time systems. Real time system is a term used to indicate a process or a system which will produce response immediately such as, navigation, missile tracking etc. The course starts with an introduction to the real time system and later emphasizes on application and benefits of real time system.

UNIT I **12 Hours**

Introduction to real time systems: Historical background, RTS Definition, Classification of Real-time Systems, Time constraints, Classification of Programs.**Computer hardware requirements for RTS:** Introduction, General-purpose computer, Single chip microcontroller, specialized processors, Process-related Interfaces, Data transfer techniques. **Concepts of computer control:** Introduction, Sequence Control, Loop control, Supervisory control, Centralized computer control, Hierarchical and Distributed system, Human-computer interface, Benefits of computer control systems.

UNIT II **10 Hours**

Operating systems: Introduction, Real-time multi-tasking OS, Scheduling strategies, Priority Structures, Task management, Scheduler and real-time clock interrupt handles, Memory Management, Code sharing, Resource control, Task co-operation and communication, Mutual exclusion, Data transfer, Liveness, Minimum OS kernel, Examples.

UNIT III **10 Hours**

Design of RTS: General Introduction: Introduction, Specification documentation, Preliminary design, Single-program approach, Foreground/background, Multi-tasking approach, Mutual exclusion, Monitors.

UNIT IV **10 Hours**

Design analysis: Introduction, Petri nets, Analysis of Petri Nets, Scheduling problem Real Time Database, Real Time Vs General Purpose Databases, Transaction priorities and Aborts, Concurrency Control, Disk Scheduling Algorithms, Maintaining Serialization Consistency.

UNIT V **10 Hours**

RTS development methodologies: Introduction, Yourdon Methodology, Ward and Mellor Method, Hatley and Pirbhai Method, MASXOT, PAISLEY System.

TEXT BOOK:

Real - Time Computer Control- An Introduction – Stuart Bennet,, 2nd Edn. Pearson Education. 2005.

REFERENCE BOOKS:

1. **Real-time systems design and analysis** – Phillip. A. Laplante, second edition, PHI, 2005.
2. **Embedded systems** – Raj Kamal, Tata McGraw Hill, India, 2005.

Subject Title	**Introduction to speech and audio processing**	**Credits**	**4**
Sub. Code	**10TC6GE3SA**	**L-T-P**	**3-0-1**

Objective: To introduce the fundamentals of speech signal processing and related applications. This course will present the basic principles of speech analysis and speech synthesis, and it will cover several applications including speech enhancement, speech coding and speech recognition. The course aims to deepen each student's familiarity with the practical application of signal processing in general, through the study of specific instances, and through the experience of the term project.

UNIT I **07 Hours**

Production and classification of speech sounds: Introduction, mechanism of speech production. Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates. DSP review.

UNIT II **08 Hours**

Time-domain methods for speech processing: Time dependent processing of speech, short-time energy and average magnitude, short-time average zero crossing rate, Speech vs. silence detection, pitch period estimation using parallel processing approach, short-time autocorrelation function.

UNIT III **08 Hours**

Frequency domain methods for speech processing: Introduction, definitions and properties: Fourier transforms interpretation and linear filter interpretation, sampling rates in time and frequency, Filter bank summation and overlap add methods for short-time synthesis of speech, sinusoidal and harmonic plus noise method of analysis/synthesis.

UNIT IV **08 Hours**

Linear predictive coding of speech: Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications.

UNIT V **08 Hours**

Audio Processing: Auditory perception and psychoacoustics - Masking, frequency and loudness perception, spatial perception, Digital Audio, Audio Coding - High quality, low-bit-rate audio coding standards, MPEG, AC-3, Multichannel audio - Stereo, 3D binaural and Multichannel surround sound.

TEXT BOOKS:

1. **Digital processing of speech signals** – L. R. Rabiner and R. W. Schafer, Pearson Education Asia, 2004.

2. **Fundamentals of Multimedia** - Z. Li and M.S. Drew, Pearson Education Ltd., 2004.

REFERENCE BOOKS:

1. **Discrete time speech signal processing**– T. F. Quatieri, Pearson Education Asia, 2004.

2. **Speech and audio signal processing: processing and perception of speech and music**– B. Gold and N. Morgan, John Wiley, 2004.

Subject Title	DESIGN OF ANALOG & MIXED MODE VLSI CIRCUITS	Credits	4
Sub. Code	10TC6GE3MM	L-T-P	4-0-0

Objective:This course deals with the analysis and design of analog CMOS integrated circuits, emphasizing fundamentals as well as new paradigms. The objective is to develop both a solid foundation and methods of analyzing circuits by inspection so that the student learns what approximations can be made in which circuits and how much error to expect in each approximation.

UNIT I **10 Hours**

Introduction to CMOS analog circuits **Basic MOS Device Physics:** General considerations, MOS I/V Characteristics, second order effects, MOS device models.

UNIT II **10 Hours**

Single stage Amplifier: CS stage with resistance load, divide connected load, current source load, triode load, CS stage with source degeneration, source follower, common-gate stage, cascade stage, choice of device models. **Differential Amplifiers:** Basic difference pair, common mode response, Differential pair with MOS loads, Gilbert cell.

UNIT III **10 Hours**

Operational Amplifiers: One Stage OP-Amp. Two Stage OP-Amp, Gain boosting, Common Mode Feedback, Slew rate, PSRR. Compensation of 2stage OP-Amp, Other compensation techniques

UNIT IV **10 Hours**

Data converter fundamentals: Analog versus Digital Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications, Mixed-Signal Layout Issues.

UNIT V **12 Hours**

Data Converters Architectures: DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, ADC Architectures, Flash, 2-Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.

TEXT BOOKS:

1. **Design of Analog CMOS Integrated Circuits**, B Razavi, First Edition, McGraw Hill,2001

2. **Design, Layout, Stimulation ,**R. Jacob Baker, Harry W Li, David E Boyce, CMOS Circuit, PHI Education, 2005

REFERENCE BOOKS:

CMOS Analog circuit Design Phillip. E. Allen, Douglas R. Holberg, Oxford University Press, 2002

Subject Title	Biomedical Circuits with VLSI	Credits	4
Sub. Code	10 ML6GE3BC	L-T-P	4-0-0

Objective: This subject gives an overview of VLSI, i.e. basic concepts of physical structure of CMOS integrated circuits and various layers of MOSFET. The working principle and implementation of basic gates, switches, Boolean operations and transmission gates is studied. The DC characteristics and transient response of logic gates will be explored.

Outcome: The student will be capable of exploring the applications of CMOS circuits in biomedical implantable devices and wireless integrated Neuro-chemical and Neuro-potential sensing. Like, self-powered sensors, solid state interface fabrication methods for Hollow out of plane micro-needles. CMOS circuits for wireless medical applications: like spectrum regulations integrated receiver & transmitter architecture can be undertaken.

UNIT I **08 Hours**

An Overview of VLSI: Complexity and design Basic concepts, Physical structure of CMOS integrated circuits: Integrated circuit layers, MOSFETS.

UNIT II **10 Hours**

Ideal switches and Boolean operation, MOSFETS and switches, Basic logic gates in CMOS, Complex logic gates in CMOS, Transmission gate circuits, CMOS layers, Designing FET array.

UNIT III **10 Hours**

Electronic analysis of CMOS Logic gates, DC characteristics of the CMOS Inverter, Inverter Switching characteristics, Power dissipation, DC characteristics of NAND and NOR gates, NAND and NOR transient response, Analysis of complex logic gates, Gate design for transient performance.

UNIT IV **12 Hours**

CMOS Circuits for Biomedical Implantable Devices:Introduction,Inductive Link to Deliver Power to Implants,High Data rate Transmission Through Inductive links,Energy and Bandwidth Issues in Multi –Channel Biopotential Recordings. Self-Powered Sensors and circuits for biomechanical Implants: Introduction,Fundamentals of Piezoelectric Transduction and power Delivery.CMOS Circuits for Wireless Medical Applications:Introduction,Spectrum Regulations for Medical use,Integrated Receiver Architecture, Integrated Transmitter Architecture,Radio Architecture selection,system Budget calculations,Low noise Amplifier,Mixers,PolyphaseFilter,PowerAmplifier,PLL.

UNIT V **12 Hours**

Wireless Integrated Neurochemical and Neuropotentialsensing:Introduction, Neurochemical sensing, Neuropotentialsensing,RF Telemetry and Power Harvesting in implanted Devices,Multimodal Electrical and Chemical Sensing. visual cortical Neuroprosthesis: Introduction, systemarchitecture, prosthesis Exterior Body Unit and wireless link,Body implantable unit,systemPrototype. Microneedles: A solid –state interface with the Human body Introduction,Fabrication Methods for Hollow out-of plane microneedles,Applicationsformicroneedles.

TEXT BOOKS:

1. JOHN P. UYEMURA, John Wiley , "**Introduction to VLSI circuits and systems**", Wiley 2001 edition. For Unit:1, 2,3.

2. Krzysztof Iniewski " **VLSI circuits for Biomedical Applications**" Artech House 2008 edition. For Unit 4 and 5.

REFERENCE BOOK:

Douglas A. Pucknell and Kamran Eshranghian, "**Basic VLSI Design**", PHI third edition, 2005.

Subject Title	Rehabilitation Engineering	Credits	4
Sub. Code	10ML6GE3RE	L-T-P	4-0-0

Objective: To describe the role of occupational/physical/speech therapy, rehabilitation psychology and the multidisciplinary rehabilitation team in treating disabled patients in acute and chronic care settings. To comprehend rehabilitation framework of disease, functional impairment, activity limitation and barriers to social participation in approaching neurologic problems.

Outcome: The student will be able to construct a comprehensive problem list for a patient with a disability. Perform a manual muscle test and a comprehensive back examination. Complete a functional capacity report and a department of transportation form on a person with a disability. Discuss strategies for chronic pain management.

UNIT I **12 Hours**

Introduction to Rehabilitation & Rehabilitation Team: What is Rehabilitation, Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Physiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Effects of prolonged inactivity & Bed rest on body system.

Rehabilitation Team: Classification of members, The Role of Physiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist-Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer.

UNIT II **10 Hours**

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

UNIT III **10 Hours**

Principles in Management of Communication Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids.

UNIT IV **10 Hours**

Orthotic Devices In Rehabilitation Engineering General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Biomechanics of orthoses, merits & demerits of orthotics, Material design consideration in orthotics, Calipers-FO, AFO, KAFO, HKAFO. Spinal Orthosis, Cervical, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbosacroorthosis, Splints-its functions & types.

UNIT V **10 Hours**

Prosthetic Devices Introduction, Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses – Knee unit, Axis system, Friction Mechanisms, Extension aid, Stabilizers, Socket. Disarticulation Prostheses-Knee Disarticulation Prostheses, Hip Disarticulation Prostheses.

TEXT BOOK:

Rehabilitation Medicine By Dr. S. Sunder (Jaypee medical publications, New Delhi) Physical Rehabilitation by Susan B O'Sullivan, Thomas J Schmitz. 5th edition

Subject Title	**Adaptive signal processing**	**Credits**	**4**
Sub. Code	**10EC6GE3SP**	**L-T-P**	**4-0-0**

Objectives

- To introduce the concept of adaptive signal processing.
- Understand adaptive signal processing algorithms for some applications, like adaptive noise cancellation, interference canceling, etc.

Outcome

The Students will understand concepts of adaptation and adaptive signal processing and algorithmsand will be able to work on projects in area of adaptive signal processing algorithm applied to various fields such as communications, radar, sonar, seismology, navigation systems and biomedical engineering

UNIT I **10 Hours**

Adaptive Systems: Definition and characteristics, Areas of application, General properties, Open- and closed-loop adaptation, Applications of closed-loop adaptation, Example of an adaptive system. The Adaptive Linear Combiner: General description, Input signal and weight vectors, Desired response and error, the performance function, gradient and minimum mean-square error, Example of a performance surface, Alternative expression of the gradient, Decorrelation of error and input components.

UNIT II **10 Hours**

Properties Of The Quadratic Performance Surface: Normal of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, an example with two weights, geometrical significance of eigenvectors and Eigen values, a second example.

UNIT III **10 Hours**

Searching The Performance Surface: Methods of searching the performance surface, Basic ideal of gradient search methods, a simple gradient search algorithm and its solution, Stability and rate of convergence, the learning curve,Gradient search by Newton's method in multidimensional space, Gradient search by the method of steepest descent, Comparison of learning curves.

UNIT IV **12 Hours**

Gradient Estimation And Its Effects On Adaptation: Gradient component estimation by derivate measurement, the performance penalty, Derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight-over solution, excess mean-square error and time constants, mis adjustment, comparative performance of Newton's and steepest-descent methods, Total mis adjustment and other practical considerations. The LMS Algorithm: Derivation of the LMS algorithm, convergence of the weight vector, an example of convergence, learning curve, noise in the weight-vector solution, misadjustment, performance.

UNIT V **10 Hours**

APPLICATIONS: Adaptive modeling of multipath communication channel, Adaptive modeling in FIR digital filter synthesis. The concept of adaptive noise canceling, stationary noise-canceling solutions, the adaptive interference canceller as a notch filter, multiple-reference noise canceling.

TEXT BOOKS:

1. **Adaptive Signal Processing**, Bernard Widrow and Samuel D. Stearns, Pearson Education Asia, 2001.

REFERENCE BOOKS:

1. **Adaptive filter Theory**, Simon Haykin, 4e, Pearson Education Asia, 2002
2. **Theory and Design of Adaptive Filters**, Jophn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore, Pearson education / PHI 2002.

Subject Title	**Image Processing Concepts**	**Credits**	**4**
Sub. Code	**10EC6GE3IP**	**L-T-P**	**4-0-0**

Objectives

- To provide basic theory and algorithms widely used in digital image processing
- Understand present technologies, issues.
- Understand basic Image Transform Techniques

Outcome

Students will be able to use digital image processing including the topics of filtering, transforms, and image analysis. Also they will be able to implement basic image processing algorithms in MATLAB.

UNIT I **10 Hours**

Digital Image Fundamentals: Introduction , Image Sampling, Quantization , resolution , representation ,Human visual system , Classification of Digital Images, Image types, Elements of an Image processing system, Image file formats, Applications of Digital Image Processing.

UNIT II **12 Hours**

Image Enhancement: Image Enhancement in Spatial domain, Some Basic Gray Level Trans - formations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations Basics of Spatial Filtering Image enhancement in the Frequency Domain filters, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, homomorphic filtering.

UNIT III **08 Hours**

IMAGE RESTORATION AND RECONSTRUCTION: Model of image degradation/restoration process, noise models, Restoration in the Presence of Noise, Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, inverse filtering, minimum mean square error (Weiner) Filtering.

UNIT IV **10 Hours**

COLOUR - IMAGE PROCESSING: Introduction ,Light and color, color formation, Human perception of color, Color models , Pseudo- Color image Processing, The chromaticity diagram, Color Image Quantization, histogram of color Image, Color Transforms, Smoothing and Sharpening , Noise in color Images, Color image Compression, , Segmentation.

UNIT V **12 Hours**

Image Transforms Introduction, need for transforms, orthogonal & unitary transforms, properties of unitary transforms, Importance of Phase, Fourier transform, Two-dimensional Discrete Fourier transform , Walsh Transform, Hadamard Transform, Haar Transform Slant Transform, DCT, K-L Transform, Comparison of different Image Transforms.

TEXT BOOK:

"**Digital Image Processing**", Rafael C. Gonzalez and Richard E. Woods, Pearson Education, 2009, 3rd edition.

REFERENCE BOOKS:

1. "**Fundamentals of Digital Image Processing**", Anil K. Jain, Pearson Edun, 2001.

2. "**Digital Image Processing**", S. Jayaraman, S Esakkirajan and T Veerakumar McGraw Hill , 2009

Subject Title	Robotics	Credits	4
Sub. Code	10IT6GE3RB	L-T-P	4-0-0

UNIT I **07 Hours**

Introduction Objectives, Classification of robots, Major components of robot, definitions: Kinematics, Controls, and actuators. Robot history, types and applications current and future with examples. Fixed and flexible automation

UNIT II **10 Hours**

Robot Arm Kinematics Introduction, The direct kinematics problem, Rotation Matrices, Composite rotation Matrix, Rotation matrix about arbitrary axis, Rotation matrix with Euler angle representation, Geometric interpretation of rotation matrix, Homogenous coordinates and transformation matrix, Geometric interpretation of Homogenous transformation matrices, Composite homogenous transformation matrices, Links, Joints, and their parameters, The Denavit - Hartenberg representation, Kinematic equation for manipulator, Other specifications of the locations of the end effectors, Inverse kinematics problem.

UNIT III **08 Hours**

Control of Actuators Objective, Motivation, Closed loop control in position servo, Effect of friction and gravity, Adaptive control, Optimal control, Computed torque technique, Transfer function of single joint, Position control for single joint, Brief discussion on performance and stability criteria.

UNIT IV **10 Hours**

Sensors Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor- encoders, tachometers, Acceleration sensors, Force and Pressure sensors – piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.Hall Effect sensors, Binary sensors, Analog sensors, Force and Torque sensing, Elements of a Wrist sensor.

UNIT V **10 Hours**

Vision and Processing :

Image acquisition, illumination Techniques, imaging geometry, some basic transformations, perspective transformations. Camera model, camera calibration, stereo imaging, Higher-Level Vision: Segmentation, Edge Linking and Boundary detection, Thresholding. Region-oriented segmentation, Use of motion, Description, Boundary descriptors, Regional descriptors.

Mini project: **7 Hours**

Discussion on DC motors with gears, Stepper motor, Servo motor ,Mini projects using Basic sensors, 555 timers, Motors (DC motors with gears, Stepper motor, Servo motor) A batch of TWO students are required to undertake a mini project to showcase the knowledge acquired during the course of this study.Example topics :

1. Line follower robot
2. Obstacle avoiding robot
3. Face reorganization algorithm
4. MATLAB simulation or Use of robo sim
5. PCB design workshop (Using PCB design software)

Note: Carrying out small models / prototypes of projects are mandated which will carry a 20 percent weight in CIEProject report has to be submitted with following chapters followed by a presentation

1. Abstract
2. Introduction
3. Block diagram
4. Materials used with detailed specification
5. Design and Design issues in detail
6. Model testing

TEXT BOOKS:

1. **"Robotics – control, sensing, Vision and Intelligence",** K.S.Fu, R.C.Gonzalez, C.S.G. Lee, McGraw Hill, 1987.

2. **"Robotic Engineering" -** Richard D Klafter, PHI

REFERENCE BOOKS:

1. **"Introduction to Robotics Mechanics and control",** John J. Craig, 2nd Edition, Pearson education, 2003

Subject Title	**Digital Image Processing**	**Credits**	**4**
Sub. Code	**10IT6GE3DP**	**L-T-P**	**3-0-1**

OBJECTIVES:

This course provides an understanding of basic concept and methodologies of digital image processing and develops a foundation that can be used as a basis for further study and research in this field.

OUTCOMES:

Upon completion of this course, a student:

- Will have the knowledge of digital image processing system and image model.
- Will learnt to use and apply transforms.
- Will delve into different application areas of image processing
- Will have the ability to implement the processing techniques in MATLAB.
- Will have learnt about image compression ,its new methods and standards used.
- Will have an understanding of image segmentation.

UNIT I **08 Hours**

Fundamentals and transforms: Introduction, Fundamental steps in digital image processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels Fourier transforms, Hadamard transform, Discrete cosines transform.

UNIT II **09 Hours**

Image enhancement: Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram equalization, Histogram matching (specification), Image subtraction, Image averaging, Basics of spatial filtering, Smoothing spatial and frequency domain filters Sharpening spatial and frequency domain filters –Homomorphic filtering.

UNIT III **08 Hours**

Image restoration: Image degradation and restoration models, noise models, restoration using spatial filtering – mean filter, geometric mean filter, harmonic mean filter, median filter, max & min filters, midpoint filter. noise filtering by frequency domain filtering – band reject filter, band pass filter, notch filter, inverse filtering, minimum mean square error (Wiener) filtering.

UNIT IV **07 Hours**

Image compression: Fundamentals, variable length coding, LZW coding, bit plane coding, constant area coding, run length coding, lossless predictive coding, lossy predictive coding, transform coding, image compression standards :basic, JPEG.

UNIT V **07 Hours**

Image segmentation: Introduction, thresholding: threshold detection methods, optimal thresholding, multi-spectral thresholding, edge based segmentation: edge image thresholding, border tracing, Hough transform, region-based segmentation: region merging, region splitting, splitting & merging. Matching: matching criteria.

LAB EXPERIMENTS

TEXT BOOKS:

1. "**Digital Image Processing** "Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson Education Inc.

2. "**Image Processing, analysis and machine Vision**", Milan Sonka, Vaclav Hlavac& Roger Boyle.

REFERENCE BOOK:

"**Fundamentals of Digital Image Processing**", Anil K. Jain, 2nd Edition, Prentice Hall of India.

Subject Title	**MEDICAL IMAGING**	**Credits**	**5**
Sub. Code	**11ML7DCMIG**	**L-T-P**	**4-0-1**

Objectives: Demonstrate knowledge of normal anatomic structures of the body as seen in diagnostic images. Demonstrate knowledge of various imaging modalities, identify them and understand their appropriate use in imaging. Demonstrate understanding of appropriate use of each modality and the role in patient diagnosis. Comprehensive understanding of the role of diagnostic imaging in patient care.

Outcome: To assist the student in learning to recognize normal anatomic structures as they appear in routine diagnostic imaging studies. They will be able to understand various imaging modalities available for patient evaluation, identify some of the strengths and weaknesses of each modality.

UNIT 1

X-ray Imaging **12 Hrs**

Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and

image intensifiers, X-ray detectors, X-ray image characteristics – Spatial resolution, Image noise, Image contrast, Receiver operating curve (ROC), Biological effects of ionizing radiation.Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography, Image subtraction.

UNIT-2

CT Imaging **09 Hrs**

Computed Tomography: Conventional tomography, Computed tomography – Projection function, Algorithms for image reconstruction, CT number, Image artifacts, Spiral CT. Recent developments – Digital radiography, Digital subtraction angiography (DSA), 3D reconstruction, Dynamic spatial reconstructor (DSR).

UNIT 3

Ultrasound Imaging **11 Hrs**

Fundamentals of acoustic propagation - Stress strain relationship, Characteristic impedance, Intensity, Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Transducer beam characteristics-Huygen's principle, Beam profiles, Pulsed ultrasonic field, Axial and Lateral resolution, Focusing, Arrays.

Ultrasonic Diagnostic Methods

Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Constant depth mode (C-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Power Doppler Imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound, video printers.

UNIT-4

Radionuclide Imaging **9 Hrs**

Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission –

Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic methods using radiation detector probes – Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT, PET.

UNIT-5

Basics of Magnetic Resonance Imaging **11 Hrs**

Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Rotating frame of reference and RF magnetic field, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences.

MRI System & Imaging Methods.

Introduction, Magnet, Room temperature and magnetic field gradients, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging, Blood flow imaging, Characteristics of MRI images- Spatial resolution, image contrast. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields, Imaging safety, Functional MRI.

Lab Experiments: Mini project on Different imaging modalities using Open Source Software.

Textbooks:

1. Principles of Medical Imaging by Kirk Shung, Michael B. Smith and BanjaminTsui, Academic Press, 1992.

2. Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.

3. Fundamentals of Medical Imaging by Paul Suetens, Cambridge University Press, 2002.

Subject Title	LINEAR ALGEBRA	Credits	5
Sub. Code	11ML7DCLNA	L-T-P	4-0-1

Objectives: Read and interpret mathematical texts related to Linear Algebra, accurately and rigorously express in writing their logical-deductive reasoning. Use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra of application in Engineering. Accurately use mathematical elements related to vector spaces and Euclidean vector spaces, understanding them as an abstraction of the properties of free vectors in a plane and space. Construct the most suitable basis that simplifies the solution of a problem, develop the best approximation of a vector in a subspace and apply it to the approximate solution of incompatible systems.

Outcomes

Students will be able to synthesize solutions to the problems in the subject . Also useful would be a course in the rudiments of logic and proof techniques. Students will be able to handle the fundamental concepts of linear applications, appreciate their importance in different areas of Linear Algebra in the field of engineering. Use of software tools for implementing the concepts of linear algebra.

UNIT 1 **12 Hrs**

Linear equations: Fields; system of linear equations, and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-factorization.
Vector spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces.

UNIT 2 **10 Hrs**

Linear Transformations: Linear transformations; algebra of linear transformations; isomorphism; representation of transformations by matrices; linear functional; transpose of a linear transformation.

UNIT 3 **10 Hrs**

Canonical Forms: Characteristic values; invariant subspaces; direct-sum decompositions; invariant direct sums; primary decomposition theorem; cyclic bases; Jordan canonical form.

UNIT 4 **10 Hrs**

Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization; least-squares problems; unitary operators.

UNIT 5 **10 Hrs**

Symmetric Matrices and Quadratic Forms: Digitalization; quadratic forms; constrained optimization; singular value decomposition. .

Lab Experiments: Implementation of Linear Algebra concepts for Medical Image and Signal processing

TEXTBOOKS:

1. Gilbert Strang, "Linear Algebra and its Applications", 4thEdition, Thomson Learning Asia, 2007.
2. David C. Lay, "Linear Algebra and its Applications", 3rd Edition, Pearson Education (Asia) Pvt. Ltd, 2005.
3. Bernard Kolman and David R. Hill, "Introductory Linear Algebra with Applications," Pearson Education (Asia) Pvt. Ltd, 7th edition, 2003.

Subject Title	POWER SYSTEM OPERATION AND CONTROL	Credits	4
Sub. Code	11EE7GE4PO	L-T-P	4-0-0

UNIT I **12 Hours**

Power system Control And operating states, digital computer configuration, automatic generation control, area control error, Automatic load frequency control, Automatic load frequency control of single area systems, Speed governing systems Hydraulic valve actuator, Turbine generator response, Static performance of speed governor, Closing of ALFC loop, Concept of Control Area, Static response of primary ALFC loop.

UNIT II **10 Hours**

ALFC of multi-area systems (POOL operation), the two-area system, modeling of the tie-line, Block diagram representation of Two-Area Systems, Static response of two area system and Tie line Bias Control, Automatic Voltage regulator: Basic generator control loops, Cross-coupling between control loops, Exciter types, Exciter modeling, Generator modeling, Static performance of AVR loop

UNIT III **10 Hours**

Control of voltage and reactive power: Introduction, Generation and Absorption of reactive power, Relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse, Overview of Economic Operation of Power systems without losses.

UNIT IV **10 Hours**

Unit Commitment: Statement of the unit commitment problem, need and importance of unit commitment, Constraints in unit commitment, Unit commitment solution methods- Priority lists method, Forward Dynamic Programming method, Spinning reserve.Power system security: Introduction, factors affecting power system security, an overview of security analysis, linear sensitivity factors, AC power flow methods, contingency evaluation, techniques for contingency evaluation

UNIT V **05 Hours**

System monitoring and control: Introduction, Energy Management systems, the basis of power system state estimation (PSSE), mathematical description of PSSE process, minimization technique for PSSE, Least square estimation, Error and detection in PSSE, System security and emergency control.

TEXT BOOKS:

1. **Modern Power System Analysis-** I J Nagarath and D P Kothari, TMH, 3rd Edition, 2003
2. **Electrical Energy Systems Theory**, O.J Elgerd, TMH,2008.
3. **Power generation, operation and control**- Allen J Wood & Woollenberg. John Wiley and Sons, Second Edition, 2009.
4. **Electric Power Systems-** B.M.Weedy and B.J. Cory, Wiley student edition, 1999
5. **Computer Aided Power System Operation and Analysis-** R.N. Dhar, Tata McGraw-Hill, 1987.

REFERENCE BOOKS:

1. **Computer Aided Power System Analysis-** G.L.Kusic, PHI,2010.
2. **Power System Analysis, Operation and Control,** Abhijit Chakrabarti and Sunita Halder, PHI, Second Edition, 2009

Subject Title	**INDUSTRIAL DRIVES &APPLICATIONS**	**Credits**	**4**
Sub. Code	**11EE7GE4ID**	**L-T-P**	**4-0-0**

ObjectiveWith the increase in the demand for power electronics devices, the use of power electronics, in drive circuits have increased. DC & AC motors can be controlled using highly compact power electronics circuits. This subject is versatile and can be useful to all students of the electrical cluster stream.

UNIT I **08 Hours**

AN INTRODUCTION TO ELECTRICAL DRIVES & ITS DYNAMICS: Electrical drives. Advantages of electrical drives, Parts of electrical drives, choice of electrical drives, status of dc and ac drives, Dynamics of electrical drives, Fundamental torque equation, speed torque conventions and multiquadrant operation. Equivalent values of drive parameters, components of low torques, nature and classification of load torques, calculation of time and energy loss in transient operations, steady state stability, load equalization.

UNIT II **10 Hours**

SELECTION OF MOTOR POWER RATING: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating. **INDUSTRIAL DRIVES**: Rolling mill drives, cement mill drives, paper mill dries and textile mill drives.

UNIT III **12 Hours**

D C MOTOR DRIVES: (a) Starting braking, transient analysis, single phase fully controlled rectifier, control of dc separately excited motor, Single-phase half controlled rectifier control of dc separately excited motor.**(b)** Three phase fully controlled rectifier control of dc separately excited motor, three phase half controlled controlled rectifier control of dc separately excited motor, multiquadrant operation of dc separately excited motor fed form fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper chopper control of separately excited dc motor. Chopper control of series motor.

UNIT IV **12 Hours**

INDUCTION MOTOR DRIVES: (a) Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting braking, transient analysis. **(b)** Stator voltage control variable voltage frequency control from voltage sources , voltage source inverter control, closed loop control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery, speed control of single phase induction motors.

UNIT V **10 Hours**

SYNCHRONOUS MOTOR DRIVES: Operation form faced frequency supply, synchronous motor variable speed drives, and variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thruster inverter.

TEXT BOOK:

Fundamentals of Electrical Drives, G.K Dubey , Narosa publishing house, 2nd Edition,2002.

REFERENCE BOOKS:

1. **Electrical Drives**, N.K De and P.K. Sen- PHI, 2009.

2. **A First Course On Electric Drives**, S.K Pillai-Wiley Eastern Ltd 1990.

Subject Title	LOW POWER MICROCONTROLLER	Credits	4
Sub. Code	11TC7GE4MC	L-T-P	4-0-0

Objectives

- To discuss the key features and benefits of MSP 430 microcontroller.
- To discuss the low power operation capabilities of the device
- To discuss the various integrated peripherals
- To discuss the development tools and its use in Real Time Embedded Applications

UNIT I **08 Hours**

Introduction - Motivation for MSP430microcontrollers – Low Power embedded systems Main characteristics of a MSP430 microcontroller, Main features of the MSP430X RISC CPU architecture, Address space, Interrupt vector table, Flash/ROM, Information memory (Flash devices only), Boot memory (Flash devices only), RAM, Peripheral Modules, Special Function Registers (SFRs), Central Processing Unit (MSP430 CPU), Arithmetic Logic Unit (ALU), MSP430 CPU registers, Central Processing Unit (MSP430X CPU), MSP430X CPU registers.

UNIT II **08 Hours**

Addressing modes & Instruction set- Double operand instructions, Single operand instructions, Program flow control – Jumps, Emulated instructions and programming.

UNIT III **08 Hours**

Device Systems and Operating Modes- system reset, system clock, interrupt management, WDT, WDT+, Basic Timer, Capture/Compare blocks, Timer_A Interrupts, Timer_B special features, Real Time Clock (RTC).

UNIT IV **08 Hours**

On-Chip Peripherals and General Purpose I/O- Hardware multiplier, ADC, DAC, SD16, LCD, DMA, Registers, Interruptible ports, Flashing LED, Blinking the LED, toggle the LED state by pressing the push button, Enable / disable LED blinking by push button.

UNIT V **07 Hours**

Communications: Communications system model, Transmission mode, Synchronous and asynchronous serial communications, Serial Peripheral Interface (SPI) communication protocol, MSP430 communications interfaces, Case Studies of applications of MSP430

Lab Experiments Basic debug introduction using CCE, eZ430-RF2500 Flashing LED, Memory clock with Basic Timer 1, Real Time Clock with Basic Timer 1, LCD message Display , Sample Temperature using SAR ADC10, Temperature data logger using ADC10 , Data acquisition using ADC12 MSP430-EXP430FG4618 Flashing LED, Voltage ramp generator, Data Memory transfer triggered by software , Multiplication without hardware multiplier, Flash memory programming with the CPU executing the code from flash memory.

REFERENCE BOOKS:

1. John H Davies, MSP430 Microcontroller Basics, Newnes Publications, 2008
2. Teaching MSP430, CD provided by Texas Instruments
3. Chris Nagy, Embedded systems Design using TI MSP430 Series, Newnes Publications, 2003

Subject Title	SATELLITE COMMUNICATION	Credits	4
Sub. Code	11TC7GE4SC	L-T-P	4-0-0

Objective:

To study the different components of the satellite communication system such as attitude and orbit control, TT&C, communication, antennas. To know the development of Indian space programmes.

UNIT I **11 Hours**

OVER VIEW OF SATELLITE SYSTEMS: Introduction, frequency allocation, INTEL Sat, India in space. ORBITS: Kepler laws, orbital elements, orbit perturbations, inclined orbits, calendars, orbital plane and sun synchronous orbits, Geostationary orbit: antenna look angles, limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits

UNIT II **11 Hours**

PROPAGATION IMPAIRMENTS AND SPACE LINK: Introduction, atmospheric loss, ionospheric effects, rain attenuation, other impairments.SPACE LINK**:** Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR

UNIT III **10 Hours**

SPACE SEGMENT: Introduction, Power supply units, Attitude control, Station keeping, Thermal control, Telemetry tracking and command, Transponders, Antenna subsystem

UNIT IV **10 Hours**

SATELLITE ACCESS: Pre-assigned FDMA, SCPC (spade system), TDMA, pre-assigned TDMA, demand assigned TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, On board signal processing, satellite switched TDMA.

UNIT V **10 Hours**

SATELLITE SERVICES: DBS, orbital spacing, power ratio, frequency and polarization, transponder capacity, bit rates for digital TV, satellite mobile services, VSAT, RadarSat, GPS, orbcomm

TEXT BOOK:Satellite Communications, Dennis Roddy, 4th Edition, McGraw-Hill International edition, 2006.

REFERENCE BOOKS:

1. **Satellite Communications**, Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley & Sons, 2003.
2. **Satellite Communication Systems Engineering**, W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education., 2007.
3. **Satellite Communication Systems Engineering-**Louis J. Ippolito Jr, Wiley Publishers.

Subject Title	INTRODUCTION TO MULTIMEDIA CONCEPTS	Credits	4
Sub. Code	11TC7GE4MM	L-T-P	4-0-0

Objective:

The objective of the subject is to introduce the students to the world of multimedia. Multimedia is a term used to indicate multiple medium of communication i.e. Text, Audio, Image and Video. The course starts with an introduction to all the media and later emphasizes on their respective processing which includes various compression standards.

UNIT I **07 Hours**

FUNDAMENTALS OF MULTIMEDIA COMMUNICATIONS: Introduction, multimedia information representation, multimedia networks: telephone networks, data networks, broadcast television networks, ISDNs, broadband multiservice networks, multimedia applications: interpersonal communications, interactive applications over internet, entertainment applications.

UNIT II **08 Hours**

MULTIMEDIA INFORMATION REPRESENTATION & MULTIMEDIA NETWORKS: Media types, communication modes, network types, multipoint conferencing: centralized, decentralized and hybrid modes, network QoS, basic digital principles for multimedia.

Introduction to networks in multimedia domain, Local Area Networks, concept of Ethernet, Token ring, brief overview of Bridges.

UNIT III **08 Hours**

TEXT REPRESENTATION AND COMPRESSION: Text representation, Unformatted text, Formatted text, Hypertext, Introduction to compression techniques in multimedia, Text compression principles, Entropy encoding, Source encoding, Transform encoding, Text compression principles: Static Huffman coding ,Arithmetic coding, Basics of LZW coding, Brief overview of other text compression standards.

UNIT IV **08 Hours**

IMAGE REPRESENTATION AND COMPRESSION: IMAGE: Image representation: Graphics, Digitized documents, Digitized Pictures, Raster scan principles, Three color image capture methods, Image compression principles, Image compression techniques: Graphics Interchange Format, JPEG: Image Preparation, Block Preparation, DCT, Quantization, Entropy encoding, Frame builder, Basics of JPEG decoder, Introduction to TIFF and JPEG 2000.

UNIT V **08 Hours**

AUDIO AND VIDEO COMPRESSION: Introduction to audio compression, PCM Speech, CD quality audio, Synthesized audio, MIDI, Brief overview of various audio compression standards. Introduction to Video compression: Broadcast TV, Color signals, Luminance and Chrominance, Signal bandwidth, digital video: 4:2:2 format, 4:2:0 format, HDTV format, Video compression techniques: H.261, Introduction to MPEG and Brief overview of other MPEG standards.

LAB EXPERIMENTS AND MINI PROJECT: The students are expected to develop a mini project using the idea of multimedia communication.

TEXT BOOK:Multimedia Communications: Applications, Networks, Protocols, and Standards – Fred Halsall, Pearson Education, Second Indian reprint 2002.

REFERENCE BOOK:Data Compression: The Complete Reference – David Salomon, Springer, Fourth Edition, 2007.

Subject Title	MEDICAL IMAGING SYSTEMS	Credits	4
Sub. Code	11IT7GE4MI	L-T-P	4-0-0

Objective:

The course focuses in the area of Therauptic instruments . The evolution of ultrasonic medical imaging, computerized tomography & NMR Scanners are introduced in the syllabus to provide an inner depth to theses diagnostic equipments / instruments .

- development of prototype
- Applying this knowledge in the design of smart sensors with portable equipment.

UNIT I **10 Hours**

X-RAYS: Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers.

UNIT II **09 Hours**

COMPUTED TOMOGRAPHY: Conventional tomography, Computed tomography principle, Projection function Generations of CT machines, Electron beam CT, Reconstruction algorithms, Helical CT.

UNIT III **09 Hours**

ULTRASOUND IMAGING: Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging.

UNIT IV **11 Hours**

MAGNETIC RESONANCE IMAGING: Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, Free induction decay, Relaxation times, Pulse sequences. Introduction to functional MRI.

UNIT V **13 Hours**

THERMAL IMAGING: Medical thermography, Infrared detectors, Thermographic equipment, Pyroelectric vidicon camera.

RADIONUCLIDE IMAGING: Interaction of nuclear particles and matter, Nuclear sources, Radionuclide generators, Nuclear radiation detectors, Rectilinear scanner, scintillation camera, SPECT, PET

TEXT BOOKS:

1. **Principles of Medical Imaging**- Kirk shung, Academic Press.
2. **Handbook of Biomedical Instrumentation**- Khandpur, Tata McGraw-Hill Publishing Company Ltd., 2nd Edition, 2003.

REFERENCE BOOKS:

1. **Medical Imaging Signals and Systems**- Jerry L Prince and Jonathan M Links, Prentice Hall of India/Pearson Education.
2. **Fundamentals of medical Imaging**- Zhong Hicho and Manbir singh, John Wiley.

Subject Title	HOSPITAL MANAGEMENT SYSTEMS	Credits	4
Sub. Code	11ML7GE4HM	L-T-P	4-0-0

Objective: Human Resource Management is a management function concerned with hiring motivating & maintaining people in an organization. It focuses on people in an organization. It helps in manager recruitment, selection, and training. It aims at developing these members for an organization.**Outcome**: The student will be capable of understanding the skills needed to survive in the highly competitive world. To know how managers are being pressured to improve quality, increase productivity, cut down waste and to eliminate inefficiency. The collective efforts of the employer and employee will be known.

UNIT I **08 Hours**

Introduction to data base management systems: Managing data, A Historical perspective, File systems versus a DBMS: Advantages, Describing and Storing data, Queries, Transaction management, Structure. People who work with databases, Artificial Intelligence in Medicine, The Structure of Medical Informatics.

UNIT II **12 Hours**

Hospital Information System: Introduction, HMIS: Need, Benefits, Capabilities, Development, Functional areas. Modules forming HMIS, HMIS and Internet, Pre-requisites for HMIS, PACS, why HMIS fails, health information system, disaster management plans, advantages of HMIS, Security of computer records, The HELP System, Sources of Data for Decision –Making, Modes of Decision Output to physician

UNIT III **12 Hours**

Computerized Patient Data Base Management: Introduction, History-taking by computer, Dialogue with the computer, Methods of history taking by computers, Patient data base management by computers Computerized medical record –Evolution. Computers in Clinical Laboratory: Introduction, Data base approach to Laboratory Computerization, Automated Clinical Laboratories, Automated Methods in Hematology, Chromosome Analysis by computer, Computerized Electrocardiography (ECG), Assessment of performance of ECG computer programs, Computerized Electroencephalography, Computerized Electromyography.

UNIT IV **10 Hours**

Computer-Assisted Medical Decision- Making: Introduction, General Model of CMD, Algorithmic Methods, Statistical pattern classification, Decision Analysis, Fuzzy set theory, Production Rule Systems, Cognitive Models, Internist, QMR, KES, A rule based decision aid for TIA.

UNIT V **10 Hours**

Computers in the care of Critically Ill Patients: Automated computer Assisted Fluid and Metabolic balance, Pulmonary Function Evaluation, Cardiovascular Physiologic Evaluation. Computer-Assisted Therapy: Introduction, Digitalis Therapy, Evaluation of Patient response, Assessing Digitalis Toxicity, Computers for care of renal disorders, Computer based cancer Chemotherapy protocol advisor- ONCOCIN, Automated Drug delivery, Electromyogenic Controlled Limbs. Computer Aids for the Handicapped**:** Introduction, Mobility, Blind and Visually Handicapped, Computer aids for the deaf, computer speech generation and recognition.

TEXT BOOKS:

1. Data base Management systems (Third Edition)— Raghu Ramakrishna and Johannes Gehrke, McGraw-Hill, 2003

2. Computers in Medicine— R.D. LELE- Tata McGraw-Hill.

3. Medical Informatics: A Primer by Mohan Bansal, TMH publications

Subject Title	PHYSIOLOGICAL CONTROL SYSTEMS	Credits	4
Sub. Code	11ML7GE4PC	L-T-P	4-0-0

Objective: This course will help the students to gain a better understanding of how the principles of control theory, systems analysis, and model identification are used in physiological regulation. It also emphasizes the concepts of classical control theory and its application to physiological systems, and contemporary topics and methodologies shaping bioengineering research today.**Outcome:** The student will be capable of understanding the concept and different mathematical techniques applied in analyzing any given system. Will be able to learn to do the analysis of given system in time domain and frequency domain, the techniques of plotting the responses in both domain analysis and apply these analysis to study the biological systems.

UNIT I[12 hours]

INTRODUCTION & MATHEMATICAL MODELING: History & Preliminaries, Fundamental concept, PCS an example. Generalized system properties, Models with combination of system elements, Linear models, parameter models, Linear systems, transfer functions, Computer analysis & simulation – Matlab & Simulink

UNIT II **09 Hours**

STATIC ANALYSIS OF PHYSIOLOGICAL SYSTEMS: Introduction, open loop Vs closed loop, determination of steady state operating point, steady state analysis using Simulink, regulation of cardiac output, regulation of glucose, chemical regulation of ventilation.

UNIT III **09 Hours**

TIME DOMAIN ANALYSIS OF LINEAR CONTROL SYSTEMS: Linearized respiratory mechanics, open & closed loop responses, Impulse & step response descriptors, transient response analysis using Matlab, SIMULINK applications.

UNIT IV **10 Hours**

FREQUENCY DOMAIN ANALYSIS OF LINEAR CONTROL SYSTEMS: Steady state response, frequency response & analysis, frequency response model of a circulatory control, frequency response of glucose insulin regulation.

UNIT V **12 Hours**

STABILITY ANALYSIS – LINEAR APPROACHES: Stability & transient responses, Root locus plots, Routhhurwitz stability criterion, Nyquist stability for stability, Relative stability, Stability analysis of pupillary light reflexes, Model of chynestokes breathing

TEXT BOOK:'Physiological Control Systems – Analysis, Simulation & Estimation', by Michael C Khoo, Wiley IEEE press

REFERENCE BOOK:

1. 'Applications of control theory to physiological systems', Milhorn
2. 'Biological control system analysis', J H Milsum
3. 'Biological Engineering Principles', David C Cooney

Subject Title	WIRELESS COMMUNICATION	Credits	4
Sub. Code	11EC7GE4WC	L-T-P	4-0-0

Objectives

- This course introduces the student to the concepts of cellular communication.
- To enable the students to understand the various modulation techniques, propagation methods, coding and multiple access techniques used in wireless communication.
- Study the second generation digital cellular networks in detail.

UNIT I **08 Hours**

Introduction: Application and requirements of wireless services, History, types of services, requirements for services, Economical and social aspects. Spectrum limitations, limited energy, user mobility.

UNIT II **12 Hours**

The Cellular concept: System design fundamentals: Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Trunking and Grade of service, Improving coverage and capacity in cellular system.

UNIT III **12 Hours**

Mobile radio propagation: Large scale path loss – Introduction to Radio wave propagation, free space propagation model, relating power to electric field, Reflection, Ground Reflection model, Diffraction, Scattering.Small scale fading- small-scale multipath propagation, Impulse response model of a multipath channel, small scale multipath measurements, Parameters of mobile multipath channels, Types of small scale fading.

UNIT IV **10 Hours**

Equalization and Diversity: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in communication receiver, Survey of Equalization Techniques, Linear and non-linear equalization, Algorithms for Adaptive Equalization, Fractionally Spaced equalizers, Diversity techniques, RAKE receivers.

UNIT V **10 Hours**

Global System for Mobile communication: System overview, The air interface, Logical and physical channels, synchronization, coding , circuit switched data transmission, Establishing a communication and handoff, Services and billing.

TEXT BOOKS:

1. **Wireless Communication**- Andreas F Molish, Wiley Student, Second Edition (Units 1&5)
2. **Wireless Communication- Principles and Practice**, Theodre S Rappaport, Second Edition (Units 2, 3&4)

Subject Title	**EMBEDDED SYSTEM DESIGN**	**Credits**	**4**
Sub. Code	**11EC7GE4ES**	**L-T-P**	**4-0-0**

Objectives

- Introduce to features that build an embedded system.
- To understand the interaction of the various components within embedded system and the techniques of interfacing between processors & peripheral device related to embedded processing.
- To understand the basic concepts of systems programming like operating system, assembler compliers etc and the management task needed for developing embedded system.

UNIT I **10 Hours**

Introduction to Embedded System:

Introduction to functional building blocks of embedded systems – Register, memory devices, ports, timer, and interrupt controllers using circuit block diagram representation for each category.

UNIT II **08 Hours**

Processor and Memory Organization: Structural units in a processor; selection of processor & memory devices; shared memory; DMA; interfacing processor, memory and I/O units; memory management – Cache mapping techniques, dynamic allocation - Fragmentation.

UNIT III **10 Hours**

Devices & Buses for Devices Network: I/O devices, timer & counting devices; serial communication using I2C, CAN, USB buses; parallel communication using ISA, PCI, PCI/X buses, arm bus; interfacing with devices/ports, device drivers in a system – Serial port & parallel port.

UNIT IV **12 Hours**

I/O Programming Schedule Mechanism: Intel I/O instruction – Transfer rate, latency; interrupt driven I/O - Non-maskable interrupts; software interrupts, writing interrupt service routine in C & assembly languages; preventing interrupt overrun; disability interrupts.Multi threaded programming – Context switching, premature & non-premature multitasking,semaphores.Scheduling – Thread states, pending threads, context switching, round robin scheduling, priority based scheduling, assigning priorities, deadlock, watch dog timers.

UNIT V **12 Hours**

Real Time Operating System (RTOS): Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools

TEXT BOOKS:

1. Rajkamal, **'Embedded System – Architecture, Programming, Des**ign', Tata McGraw Hill, 2003.

2. Daniel W. Lewis '**Fundamentals of Embedded Software'**, Prentice Hall of India, 2004.

REFERENCE BOOK:

1 David E. Simon, `**An Embedded Software Primer'**, Pearson Education, 2004.

2 Frank Vahid `**Embedded System Design – A Unified hardware & Software Introduction**' John Wiley, 2002.

3 Sriram V. Iyer, Pankaj Gupte, `**Embedded Real Time Systems Programming'**, Tata McGrawHill,2004.

4 Steve Heath, **`Embedded System Design'**, II edition, Elsevier, 2003

Subject Title	**DISTRIBUTED COMPUTING**	**Credits**	**4**
Sub. Code	**11IT7GE4DC**	**L-T-P**	**4-0-0**

Objectives:

This course is designed to provide clear understanding of fundamental concept and design principles that underlie a distributed computing system.

UNIT I **10 Hours**

INTRODUCTION: Scope, goals, motivation, historical development, architectural models, design issues. **NETWORKS & PROTOCOLS:** Computer network principles, local network technologies, protocols for distributed systems, asynchronous transfer mode network.

UNIT II **10 Hours**

REMOTE PROCEDURE CALLING: Introduction, characteristics of remote procedure calling, interface definitions, binding, the RPC software, and implementation of RPC with lightweight process.

UNIT III **11 Hours**

SYNCHRONIZATION IN DISTRIBUTED SYSTEMS: Clock synchronization, mutual exclusion, election Algorithm, dead lock in distributed systems. **PROCESS AND PROCESSOR IN DISTRIBUTED SYSTEMS:** Threads, processor allocation, scheduling.

UNIT IV **11 Hours**

DISTRIBUTED DATABASES: Division of responsibilities, file service, access control, directory service, and implementation. **STRUCTURED DISTRIBUTED DATABASES:** Overview of client server, architecture, data fragmentation, replication and allocation techniques over processing.

UNIT V **10 Hours**

CASE STUDY: Introduction, locus, sun network file system, Cambridge file server, Ameba, mach, Apollo domain.

TEXT BOOKS:

1. **"Modern Operating Systems ",** A S Tanenbaum PHI 1996

2. **"Distributed systems, concepts and design ",** George F Coulounis & Jeon dollimose

REFERENCE BOOK:

1. **"Distributed computing systems, synchronization, control and communication "**Parkar & Venis J P; Academic press 1983

2. **"Distributed data base principles and systems",** Ceri S & Pelagatt, Mc-Graw Hill 1984

3. **"Distributed operating systems",** Pradeep K Sinha —PHI 1998.

Subject Title	SWITCH MODE POWER SUPPLIES	Credits	4
Sub. Code	11EE7GE5SP	L-T-P	4-0-0

UNIT I **10 Hours**

INTRODUCTION TO DC-DC SWITCHED MODE CONVERTERS: Basic Topologies, Buck, boost, buck-boost, and Cuk converters.

UNIT II **08 Hours**

FULL BRIDGE DC-DC CONVERTER: Detailed theory, working principles, modes of operation, with detailed circuits and wave forms, applications, merits and demerits (Operation of the above converters is CCM mode only)

UNIT III **10 Hours**

DC-AC SWITCHED MODE INVERTERS: Single-phase inverter, three phase inverters. SPWM inverter, detailed theory, working principles, modes of operation with circuit analysis, applications, merits and demerits, problems based on input output voltage relationship.

UNIT IV **14 Hours**

RESONANT CONVERTERS: Zero voltage and zero current switching, resonant switch converters, and comparison with hard switching, switching locus diagrams, and working principle. **HIGH FREQUENCY INDUCTOR AND TRANSFORMERS**: Design principles, definitions, comparison with conventional design and problems.(Examples of Inductor and Transformer design for forward and flyback converter)

UNIT V **10 Hours**

POWER SUPPLIES: Introduction, DC power supplies: fly back converter, forward converter, push-pull converter, half bridge converter, full bridge converter, AC power supplies: switched mode ac power supplies, resonant ac power supplies, bidirectional ac power supplies.

TEXT BOOKS:

1. **Power Electronics-** converters, application & design**-** Mohan N, Undeland T.M., Robins, W.P-John Wiley 1989

2. **Power Electronics-Circuits, Devices,** Applications**-** Rashid M.H.-3rd Edition, Prentice Hall India, 2008.

3. **Power Electronics and A.C. Drives-** Bose B.K.-Prentice Hail 1986.

4. **Digital Power Electronics And Applications-** Muhammad Rashid. first edition, 2005, Elsevier

Subject Title	ELECTRICAL POWER QUALITY	Credits	4
Sub. Code	12EE7GE5PQ	L-T-P	4-0-0

UNIT – 1 **09 Hours**

Introduction to Power Quality; Definition Of Power Quality; Causes Of Disturbances In Power Systems; Need For Power Quality, Power Quality Evaluation Procedure.

UNIT- 2 **09 Hours**

Classification Of Power Quality Issues; Transients, Short Duration Voltage Variations, Long Duration Voltage Variations, Voltage Imbalance, Waveform Distortions, Voltage Fluctuations And Flicker, Power Frequency Variations.

UNIT -3 **12 Hours**

Measures used for power quality; harmonics, average value of non sinusoidal waveform, RMS value of non sinusoidal waveform, form factor(FF), ripple factor(RF), harmonic factor(HF), lowest order harmonic(LOH), total harmonic distortion(THD), total inter harmonic distortion (TIHD), total sub harmonic distortion(TSHD), total demand distortion (TDD), distortion power (D).

UNIT -4 **10 Hours**

Power Quality Measurement Equipment; Types Of Instruments, Wiring And Grounding Testers, Multi-Meters, Digital Cameras, Oscilloscopes, Disturbance Analyzers, Spectrum Analyzers And Harmonic Analyzers, Flicker Meters, Smart Power Quality Meters, Transducer Requirements.

UNIT – 5 **12 Hours**

Overview Of Mitigation Methods; From Fault To Trip, Reducing The Number Of Faults, Reducing The Fault-Clearing Time, Changing The Power System, Installing Mitigation Equipment , Improving Equipment Immunity, Different Events And Mitigation Methods, Summary and future direction.

TEXT BOOKS:

1. Power quality in power systems and electrical machines- Ewald F Fuchs: Mohammad A S Masoum; First Indian Reprint 2009, Indian reprint ISBN: 978-81-312-2350-5; Academic Press-An imprint of Elsevier

2. Electrical power systems quality, Second Edition, Roger, C Dugan/Mark F McGranaghan/ Surya Santosa/H Wayne Beaty; Tata McGraw Hill Edition.

REFERENCE BOOK

Understanding Power quality problem: voltage fags and interruptions by Mat H Bollen, First Edition, IEEE Press

Subject Title	EMC –EMI	Credits	4
Sub. Code	11TC7GE5EM	L-T-P	4-0-0

Objective:

To study the effect of radiation in the increasingly wireless world and to arrive at ways of handling electromagnetic compatibility and interference.

UNIT I **11 Hours**

BASIC CONCEPTS: Definition of EMC, EMI with examples, SMPS, UPS, Classification of EMC/EMI-CE,RE,CS,RS, Units of parameters, Sources of EMI, EMI coupling modes-CM,DM,ESD phenomena and effects, Transient phenomena and suppression

UNIT II **11 Hours**

EMI MEASUREMENTS : Basic principles of RE,CE, RS, CS measurements, EMI measuring instruments-Antennas, LISN, feed through capacitor, current probe, EMC analyzer, and detection technique, open area site, shielded anechoic chamber, TEM cell

UNIT III **10 Hours**

EMC STANDARD AND REGULATIONS: National and international standardizing organizations,-FCC, CE, and RE standards, frequency assignment-spectrum conversation

UNIT IV **10 Hours**

EMI CONTROL METHODS AND FIXES: Shielding, grounding, bonding, filtering, EMI gasket, isolation transformer, optical isolator

UNIT V **10 Hours**

EMC DESIGN AND INTERCONNECTION TECHNIQUES: Cable routing and connection, component selection and mounting, PCB design-Trace routing, impedance control, decoupling, zoning and grounding

TEXT BOOK:

1. Prasad Kodali.V - Engineering Electromagnetic Compatibility - S.Chand&Co - New Delhi - 2000

2. Clayton R.Paul - Introduction to Electromagnetic compatibility - Wiley & Sons - 1992

REFERENCE BOOKS:

1. Keiser - Principles of Electromagnetic Compatibility - Artech House - 3rd Edition - 1994

2. Donwhite Consultant Incorporate - Handbook of EMI / EMC - Vol I - 1985

Subject Title	SOFTWARE DEFINED RADIO	Credits	4
Sub. Code	11TC7GE5SR	L-T-P	4-0-0

Objective: This subject knowledge is helpful because in today's radio communication system where components that have been typically implemented in hardware such as mixers, filters, amplifiers, modulators/demodulators, detectors, etc. are instead implemented by means of software on a personal computer or embedded computing devices.

UNIT I **10 Hours**

Introduction Software Based Radio, A Multi-Dimensional Model Sets the Stage, What is Software Based Radio , Software Defined Radio and Software Radio , Adaptive Intelligent Software Radio and Other Definitions , Functionality, Capability and SBR Evolution , Architectural Perspectives for a Software Based Radio , The Radio Implementer plane , The Network Operator plane, Software Radio Concepts , Adoption Timeframes for Software Based Radio, Realization of Software Based Radio Requires New Technology , Power/Performance/Price Limitations of Handsets Dictates Inflexible Networks, Regulatory Concepts Facilitate SBR Introduction

UNIT II **12 Hours**

Radio Frequency Translation for Software Defined Radio Requirements and Specifications , Transmitter Specifications , Receiver Specifications, Operating Frequency Bands ,Receiver Design Considerations , Basic Considerations , Receiver Architectures , Dynamic Range Issues

and Calculation , Adjacent Channel Power Ratio (ACPR) and Noise Power Ratio (NPR), Receiver Signal Budget , Image Rejection , Filter Functions within the Receiver , Transmitter Design Considerations , Filtering Analogies between Receiver and Transmitter ,Transmitter Architectures, Transmitter Efficiency and Linearity ,Candidate Architectures for SDR , Zero IF Receivers, Quadrature Local Oscillator, Variable Preselect Filters , Low IF Receivers

UNIT III **10 Hours**

Radio Frequency Front End Implementations for Multimode SDRs Evolution of Radio Systems , Evolution of RF Front Ends – Superheterodyne Architecture , The AN2/6 Product Family – Dual Band, Six Mode , The AN2/6 Architecture , Lessons Learned From the AN2/6 , Alternative RF Front End Architectures , Direct Conversion RF Front Ends , Pure Digital RF Front Ends , Analog Digital Combination Solutions , Directions for a Completely Successful SDR RF Front End

UNIT IV **10 Hours**

Data Conversion in Software Defined Radios The Importance of Data Converters in Software Defined Radios , ADCs for SDR Base Stations , ADCs for SDR Handsets , DACs for SDR Applications , Converter Architectures ,Flash Converters , Multistage Converters , Sigma-Delta Converters , Digital-to-Analog Converters , Converter Performance Impact on SDR , Noise Sources – Impact on SDR Sensitivity , SNR of Data Converter , Spurious Impact on Performance , Digital-to-Analog Converter Specification

UNIT V **10 Hours**

The Digital Front End: Bridge Between RF and Baseband Processing The Front End of a Digital Transceiver, Signal Characteristics , Implementation Issues , The Digital Front End , Functionalities of the Digital Front End , The Digital Front End in Mobile Terminals and Base Stations , Digital Up- and Down-Conversion , Initial Thoughts , Theoretical Aspects , Implementation Aspects , The CORDIC Algorithm , Digital Down-Conversion with the CORDIC Algorithm , Digital Down-Conversion by Subsampling , Channel Filtering , Low-Pass Filtering after Digital Down-Conversion , Band-Pass Filtering before Digital Down-Conversion, Filterbank Channelizers , Sample Rate Conversion , Resampling after Reconstruction , Rational Factor SRC , Integer Factor SRC

,Concepts for SRC ,Systems for SRC ,Example ,Design Parameters ,Digital Down-Conversion ,Sample Rate Conversion , Channel Filtering

Mini Project: At the end of the course students are expected to submit a miniproject on SDR implementation using Matlab /C/ LabVIEW /FPGA/DSP Processor/ARM Processor

TEXT BOOK: Software Defined Radio: Dr Walter Tuttlebee, Wiley

REFERENCE BOOKS:

1. **Bruce Fett, 'Congitive Radio Technology', Newnes**
2. **'Huseyin Arslan, 'Congitive radio, software defined radio and adaptive wireless systems', Springer**

Subject Title	**ASIC DESIGN**	**Credits**	**4**
Sub. Code	**11ES7GE5AD**	**L-T-P**	**4-0-0**

Subject TitleASIC DESIGN Credits4Sub.Code11TC7GE5ADL-T-P4-0-0Objective: The course deals with the study of the hardware structure, synthesis methods, design methodology and design flow from the application to ASIC chip.

UNIT I **10 Hours**

Introduction to ASICs Types of ASICs**:—** Full Custom with ASIC, Standard Cell based ASIC, Gate array based ASIC, Channeled gate array, Channel less gate array, structured gate array, Programmable logic device, Field programmable gate array. Design flow, ASIC cell libraries

UNIT II **10 Hours**

CMOS LOGIC Data path Logic Cells**: -** Data Path Elements, Adders, Multiplier. I/O cell, Cell Compilers **ASIC LIBRARY DESIGN** Logical effort: - practicing delay, logical area and logical efficiency logical paths, multi stage cells, optimum delay, optimum no. of stages, library cell design.

UNIT III **11 Hours**

PROGRAMMABLE ASICS The Antifuse, static RAM, EPROM and EEPROM Technology. Programmable ASIC logic cells

UNIT IV **11 Hours**

Programmable ASIC I/O cells, Programmable ASIC interconnect.

UNIT V **10 Hours**

Low-level Design Entry: Schematic Entry: -Hierarchical design. The cell library, Names, Schematic Icons & Symbols, Nets, schematic entry for ASICs, connections, vectored instances and buses, Edit in place, attributes, Netlist screener, Back annotation.

TEXT BOOK: M.J.S .Smith, - "**Application - Specific Integrated Circuits**" – Pearson Education, 2003

REFERENCE BOOKS:

1. Jose E.France, Yannis Tsividis, "**Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing**", Prentice Hall, 1994.

2. Malcolm R.Haskard; Lan. C. May, "**Analog VLSI Design - NMOS and CMOS**" Prentice Hall, 1998.

3. Mohammed Ismail and Terri Fiez, "**Analog VLSI Signal and Information Processing"**, McGraw Hill, 1994.

Subject Title	ADVANCED MEDICAL IMAGE PROCESSING	Credits	4
Sub. Code	11ML7GE5IP	L-T-P	4-0-0

Objective: The Subject aims to introduce advanced concepts and methodologies for digital image processing and implementing the various techniques of image processing to make the results (output images) more suitable than the original Bio-medical images.

UNIT I **12 Hours**

MORPHOLOGICAL IMAGE PROCESSING: Preliminaries, Erosion, Dilation, Duality, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms, Boundary Extraction, Hole Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening, Skeletons, Pruning, Morphological Reconstruction, Summary of Morphological Operations of Binary Images, Gray-Scale Morphology, Erosion and Dilation, Opening and Closing, Some Basic Gray-Scale Morphological Algorithms, Gray-Scale Morphological Reconstruction.

UNIT II **08 Hours**

IMAGE SEGMENTATION: Fundamentals, Point, Line, and Edge Detection, Background, Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection, More Advanced Techniques for Edge Detection, Edge Linking and Boundary Detection, Thresholding, Foundation, Basic Global Thresholding, Optimum Global Thresholding Using Otsu's Method, Using Image Smoothing to improve Global Thresholding, Using Edges to improve Global Thresholding, Multiple Thresholds, Variable Thresholding, Multivariable Thresholding, Region-Based Segmentation, Region Growing, Region Splitting and Merging, Segmentation Using Morphological watersheds, Background, Dam Construction, watershed segmentation Algorithm, The Use of Markers, The Use of Motion in Segmentation, Spatial Techniques, Frequency Domain Techniques.

UNIT III **10 Hours**

REPRESENTATION AND DESCRIPTION: Representation, Boundary (Border) Following, Chain Codes, Polygonal Approximations Using Minimum-Perimeter Polygons, Other Polygonal Approximation Approaches, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, Shape Numbers,

Fourier Descriptors, Statistical Moments, Regional Descriptors, Some Simple Descriptors, Topological Descriptors, Texture, Moment Invariants, Use of Principal Components for Description Relational Descriptors.

UNIT IV **10 Hours**

OBJECT RECOGNITION: Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Matching, Optimum Statistical Classifiers, Neural Networks, Structural Methods, Matching Shape Numbers, String Matching.

UNIT V **12 Hours**

WAVELETS AND MULTIRESOLUTION PROCESSING: Image Pyramids, Sub band Coding, The Haar Transform, Multi resolution Expansions, Series Expansions, Scaling Functions, Wavelet Functions, Wavelet Transforms in One Dimension, The Wavelet Series Expansions, The Discrete Wavelet Transform, The Continuous Wavelet Transform. The Fast Wavelet Transform. Wavelet Transforms in Two Dimensions. Wavelet Packets

TEXT BOOK: Digital Image Processing by RafaelC. Gonzalez & Richard E. Woods, Third Edition. Pearson Education Inc.

REFERENCE BOOKS:

1. **Digital Image Processing using MATLAB** by RafaelC. Gonzalez & Richard E. Woods, Second Edition.Pearson Education Inc.
2. **Image Processing, Analysis andMachine-Vision** by Milan Sonka,Vaclav Hlavac& Roger Boyle, Second Edition
3. **Digital Image Processing** by S Jayakumaran, S Esakkirajan, T Veerakumar, Tata McGraw Hill Education Private Ltd.

Subject Title	ADVANCED BIOMEDICAL DIGITAL SIGNAL PROCESSING	Credits	4
Sub. Code	11ML7GE5SP	L-T-P	4-0-0

Objectives: Understand the concepts of Discrete and continuous Random Variables, Probability Density Function and its types. To be able to understand the various measurement parameters based on signal processing concepts. Such as power spectral analysis on ECG,EMG,EEG signals.

UNIT I **10 Hours**

INTRODUCTION: Discrete and continuous Random variables, Probability distribution and density functions. Gaussian and Raleigh density functions, Correlation between random variables.Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth, noise figure of systems.

UNIT II **10 Hours**

TIME SERIES ANALYSIS: Introduction to time series analysis, AR, MA and ARMA models, Parameter estimation of ARMA models (Maximum likelihood method), Process order estimation, Adaptive segmentation, autocorrelation measure (ACM) method, spectral error measure(SEM) method.

UNIT III **08 Hours**

SPECTRAL ANALYSIS: Introduction to spectral analysis, the PSD, Cross – Spectral Density and coherence functions, Linear filtering, the Wiener filter, Cepstral analysis. Homomorphic filtering

UNIT IV **12 Hours**

SPECTRAL ESTIMATION: Introduction, estimation based on Fourier transform, the expected value of the Periodogram, weighted overlapped segment averaging (WOSA), smoothing of the Periodogram, estimation based on Maximum entropy method (MEM) and the AR method, the Moving average (MA) method, Autoregressive moving average (ARMA) methods, Prony's method, Maximum likely hood method (MLM), comparison of several methods.

UNIT V **12 Hours**

WAVELETS: Introduction to Wavelets: Multi resolution, Formulation of Wavelet systems, The Scaling Functions, and scaling Coefficients, Wavelet and Wavelet Coefficients, Calculation of the Discrete Wavelet Transform, Wavelet-Based Signal Processing and Applications.

TEXT BOOKS:

1. Biomedical Signal Processing: Time & Frequency Analysis (Vol-1) by Arnon Cohen., CRC Press, 1986.

2. Introduction to Wavelets and Wavelet Transforms, Burrus, Gopinath and Gao, Prentice Hall, 1998.

REFERENCE BOOKS:

1. Biomedical Signal Analysis by Rangaraj M. Rangayyan –. IEEE Press, 2001.

2. Biomedical Signal Processing by MatinAkay, Academic, Press 1994

3. Wavelet Transforms by Raghuveer M. Rao and Ajit S. Bopardikar, Pearson, 1998.

Subject Title	**LOW POWER VLSI DESIGN**	**Credits**	**4**
Sub. Code	**11EC7GE5LP**	**L-T-P**	**4-0-0**

Objectives

Low Power technology is the most needed technology of modern electronics. This course enables the student to understand the design challenges of low power techniques and its impact on low power technology.

UNIT I **08 Hours**

Introduction to Low power CMOS design: Need for Low Power VLSI chips, charging and discharging capacitance, Short circuit current in CMOS circuit, CMOS leakage current, Static current, Basic Principles of low power design, Low power figure of merit.

UNIT II **12 Hours**

Power Analysis: Simulation Power Analysis: Spice circuit simulation, Discrete transistor modeling, Gate level logic simulation, architecture level analysis, Monte-Carlo simulation, Probabilistic Power analysis: Random Logic signals, Probability and frequency, Probabilistic power analysis techniques, Signal entropy.

UNIT III **10 Hours**

Low power circuit techniques: Power consumption in circuits, Flip-flops and latches, logic, high capacitance nodes.

UNIT IV **10 Hours**

Energy recovery in CMOS: A look at practical details, retractile logic, reversible pipelines, High performance approaches.

UNIT V **12 Hours**

Clock distribution and logic synthesis for low power: Low power Clock distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Process variations in buffer and device sizing, Low power logic synthesis: Power estimation techniques, power minimization techniques.

TEXT BOOKS:

1. **Practical Low Power Digital VLSI design**, Gary Yeap, Kluwer academic publishers, 1998.

2. **Low Power design Methodologies ,** Jan M Rabaey, Massoud Pedram, Kluwer academic publishers, 2002.

REFERENCE BOOK:

1. **Low Power CMOS VLSI circuit design**, Kaushik Roy, Sharat C Prasad, Wiley Interscience publication, 2000.

2. **Low Power Design in deep submicron Electronics**, W. Nebel, J. Mermet, Kluwer academic publishers, 1997.

Subject Title	NETWORK SECURITY	Credits	4
Sub. Code	11EC7GE5NS	L-T-P	4-0-0

Objective

This course focuses on communication security in computer systems and networks and aims at providing students with a comprehensive introduction to the field of network security and services that are most essential for secure communication over the net.

UNIT I **12 Hours**

Services, Mechanisms and Attacks, The OSI security Architecture, A model for network security. Symmetric Ciphers: Symmetric Cipher model, Substitution techniques, Transposition technique, Simplified DES, Data encryption Standard, The strength of DES, Differential and linear cryptanalysis, Block cipher design principles and modes of operation.

UNIT II **10 Hours**

Introduction to finite fields- Groups ,rings and fields, modular arithmetic, Euclid's Algorithm, Finite fields of the form GF(p), Polynomial arithmetic, Finite Fields of the form GF(2^n). Prime numbers, Fermat's and Euler's Theorems, Testing for primarily, the Chinese Remainder Theorem, and Discrete logarithms.

UNIT III **10 Hours**

Principles of Public key cryptosystems, The RSA algorithm, Key Management, Diffe-Hellman Key exchange, Elliptic Curve Arithmetic, Authentication functions, Digital signatures, Digital signature standard.

UNIT IV **10 Hours**

Electronic Mail Security- Pretty Good Privacy, S/MIME Web security- Secure Electronic Transaction.

UNIT V **10 Hours**

Intruders, Intruder detection, Password management, Viruses and related threats. Firewalls Design Principles, Trusted systems.

TEXT BOOK:

1. **Cryptography and Network Security**-Principles and Practice: William Stallings, Third Edition.

REFERENCE BOOKS:

1. **Fundamentals of Network Security**-Eric Maiwald, 2009 Edition, Information Security Series
2. **Network Security-Private Communication in a public World**:Charlie Kaufman, Radia Perlman, Mike Speciner, Second Edition

Subject Title	MULTIMEDIA COMMUNICATION	Credits	4
Sub. Code	11EC7GE5MM	L-T-P	4-0-0

Objective

- To provide students with the theoretical and applicative knowledge (concepts, principles, algorithms and standards) concerning the representation and transmission of multimedia signals over communications networks.
- Multimedia data transmission over ATM, LAN and mobile networks.
- Multimedia data synchronization for transmission.

UNIT I **08 Hours**

Multimedia communications: Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, network QoS, application QoS.

UNIT II **08 Hours**

Multimedia information representation: Introduction, digital principles, text, images, audio, video.

UNIT III **12 Hours**

Text and image compression: Introduction, compression principles, text compression, image compression, JPEG 2000

UNIT IV **14 Hours**

Audio and video compression: Introduction, audio compression, DPCM, ADPCM, APC, LPC, video compression, video compression principles, H.261, H.263, MPEG, MPEG-1, MPEG-2, and MPEG-4.

UNIT V **10 Hours**

Synchronization: notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques

TEXT BOOKS:

1. Fred Halsall, ¯**Multimedia Communications** , Pearson education, 2001 (unit 1-4)

2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, ¯**Multimedia Communication Systems** , Pearson education, 2004 (unit 5)

REFERENCE BOOK: Pallapa Venkataram, ¯**Multimedia Information Systems**", Pearson education (In Press), 2005

Subject Title	COMPUTER COMMUNICATION AND NETWORKING	Credits	4
Sub. Code	11IT7GEGCN	L-T-P	4-0-0

Objective:

- To understand the state-of-the-art in network protocols, architectures, and applications.
- To understand network functional components and their interaction.

UNIT I **10 Hours**

INTRODUCTION: Uses of computer networks, Data communication, Circuit Switching, Packet Switching, Network Models, Example Networks, Network standardization. Theoretical basics of data communication, Layered tasks, OSI Model, Layers in OSI model, Functions, TCP/IP Suite, Addressing.

UNIT II **12 Hours**

DATA LINK CONTROL: Framing, Flow and error control, Protocols, Noiseless channels: Simplest protocol, Stop and wait protocol, Noisy channels: Stop and wait protocol ARQ, piggy backing, Go-Back-N ARQ, sliding window protocol, Selective repeat ARQ, HDLC, Point to point protocol. **Multiple accesses control**: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, **Controlled access**: Reservation, Polling, and Token passing

UNIT III **10 Hours**

MEDIUM ACCESS SUB LAYER: Static and dynamic channel allocation, multiple access protocols, LAN/MAN technology, Bus/Tree, Star and Ring topologies, The ring topology, Medium access control protocols, MAC performance, LAN/MAN standards, IEEE 802.2, 802.3, 802.4, IEEE802.5, 802.6, 802.11, and 802.16, Blue tooth

UNIT IV **10 Hours**

NETWORK LAYER: Unicast Routing Protocols, Multicast Routing protocols, Logical addressing, Ipv4, Ipv6 format & addressing, Transition from Ipv4 to Ipv6, Delivery, Forwarding,

UNIT V **10 Hours**

TRANSPORT LAYER: Transport layer Process to process Delivery, UDP, TCP, SCTP, Congestion, Congestion Control, Examples, QOS, and Techniques to improve QOS. **APPLICATION LAYER**: Client Server Model, Domain Name Space (DNS), Electronic mail, HTTP, world wide web (www)

TEXT BOOK:

1. Data communication and networking– Behrouz A. Forouzan, 4th Ed, TMH 2006.
2. William Stallings, Data and Computer Communications, Fifth edition, PHI, 1998.
3. Computer networks – Andrew. S. Tannenbaum

REFERENCE BOOKS:

1. Data communication and networking– **Behrouz** A. Forouzan, 3rd Ed, TMH 2006

Subject Title	**EMBEDDED SYSTEM & RTOS**	**Credits**	**4**
Sub. Code	**11IT7GE5ES**	**L-T-P**	**4-0-0**

UNIT I **10 Hours**

INTRODUCTION: An Embedded System; Characteristics of Embedded Systems; Software embedded into a system; Real Time Definitions, Events and Determinism, Synchronous & Asynchronous Events, Determinism, Sequence Control, Loop control, Supervisory control, Centralized computer control, Hierarchical and Distributed system, Human-computer interface, Benefits of computer control systems.

UNIT II **10 Hours**

OPERATING SYSTEMS: Introduction, Real-time multi-tasking OS, Scheduling strategies, Priority Structures, Task management, Scheduler and real-time clock interrupt handles, Memory Management, Code sharing, Resource control, Task co-operation and communication, Mutual exclusion, Data transfer, Liveness, Minimum OS kernel, Examples.

UNIT III **12 Hours**

REAL TIME SPECIFICATIONS AND DESIGN TECHNIQUE: Mathematical specifications, flow charts, structure charts, Finite state automata, data flow diagrams, Petri Nets, Warnier Orr Notation, State charts.**PROCESSOR AND MEMORY ORGANIZATION:** Structural Units in a Processor; Memory Devices, Memory selection for an embedded system; Direct Memory Access, DMA controllers; Interfacing Processor, Memory and I/O Devices.

UNIT IV **10 Hours**

INTERRUPT SERVICING (HANDLING) MECHANISM: Context and the periods for context switching; Deadline and interrupt latency. Language Features: Parameter passing, Recursion, Dynamic allocation, Typing, exception handling, abstract data typing.**REAL TIME KERNELS:** Real Time and Embedded Operating Systems; Interrupt Routines in RTOS environment; co routines, Interrupt driven systems, Foreground/background systems, Full-featured Real Time Operating Systems.

UNIT V **10 Hours**

INTER-PROCESS COMMUNICATION AND SYNCHRONIZATION OF PROCESSES: Multiple processes in an application; Problem of sharing data by multiple tasks and routines; Inter Process Communication, Mailboxes, Critical Regions, Semaphores, Deadlock.**PROGRAMMING LANGUAGES AND TOOLS: DESIRED LANGUAGE CHARACTERISTICS:** Data typing; Control Structures; Packages; Exception Handling; Overloading; Multitasking; Task Scheduling; Timing specification; Programming environments; Runtime support.

Lab Experiments will be conducted using low power Microcontroller MSP 430

TEXT BOOKS:

1. **Embedded Systems Architecture; Programming and Design**-Rajkamal; Tata McGraw Hill Publications.
2. **Real–Time Systems Design and Analysis––**3rd Edition, Phillip A. Laplante. Apr 2004. Wiley-IEEE Press.
3. **Real - Time Computer Control- An Introduction** – Stuart Bennet,, 2nd Edn. Pearson Education. 2005.

REFERENCE BOOKS:

1. **Real Time Systems**- C.M. Krishna, Kang G.Shin McGraw-Hill, 1997.
2. **An Embedded software primer**-David E Simon; Addison Wesley; 2000.
3. **An Introduction to Real Time Systems**-Raymond J.A. Buhr; Donald L. Bailey; Prentice Hall International; 1999.
4. **Embedded Real Time system**-Concepts, Design and Programming, Dr. K. V. K. K. Prasad Dream Tech Pres, New Delhi 2003.

Subject Title	Intellectual Property Rights	Credits	2
Sub. Code	11HS8GCIPR	L-T-P	2-0-0

Unit I **5 Hours**

Basic principles of IP laws: Introduction, Concept of property, Need for a holistic approach, Constitutional aspects of IP, Evolution of the patent system in UK, US and India, Basis for protection, Invention, Criteria for patentability, Non – patentable inventions.

Unit II **5 Hours**

Patents: Introduction, Origin and meaning of the term patent, Objective of a patent law, the legislative provisions regulating patents, principles underlying the patent law in India, patentable invention. rocedure for obtaining patent: Submission of application, Filing provisional and complete specification, Examination of the application, advertisement of the acceptance, opposition, Grant and sealing of patent, Term of the patent, compulsory license.

Provisional and complete specification: Definition of Specification, Kinds of specification, provisional specification, complete specification, Claims, Conditions for amendment.

Unit III **5 Hours**

Rights conferred on a patentee: Patent rights, Exception and limitations, Duties of a Patentee. Transfer of patent: Forms of transfer of Patent rights, Assignment, kinds of assignment, License, kinds of license, Rights conferred on a licensee, Transmission of patent by operation of law.

Infringement of patents: Construction of claims and infringement, patents held to be infringed, patents held to be not infringed.

Action for Infringement: Where a suit is to be instituted, procedure followed in the suit, Onus of establishment infringement, Defence by the defendant, The Relief's, Injunction, Damages or account of profits, patent agents, patent drafting, database searching, and Case studies.

Unit IV **6 Hours**

Copy Right: Meaning and characteristics of copy right, Indian copy right law, requirement of copy right, Illustrations copy right in literary work, Musical work, Artistic work, work of architecture, Cinematograph film, sound recording.

Author and Ownership of copy right: Ownership of copy right, Contract of service, Contract for service, rights conferred by copy right, terms of copy right, license of copy right.

Infringement of copy right: Acts which constitute infringement, general principle, direct and indirect evidence of copying, Acts not constituting infringements, Infringements in literary, dramatic and musical works, Remedies against infringement of copy right, Case studies.

Unit V **4 Hours**

Trade Marks: Introduction, Statutory authorities, procedure of registration of trademarks, rights conferred by registration of trademarks, licensing in trade mark, infringement of trade mark and action against infringement.

Text Books:

1. Dr. T Ramakrishna, "**Basic principles and acquisition of Intellectual Property Rights**", CIPRA, NSLIU -2005.
2. Dr.B.L.Wadehhra, " **Intellectual Property Law Handbook**", Universal Law Publishing Co. Ltd., 2002.

References:

1. Dr. T Ramakrishna , "**Ownership and Enforcement of Intellectual Property Rights**" , CIPRA, NSLIU -2005.
2. "**Intellectual Property Law (Bare Act with short comments)**",Universal Law Publishing Co. Ltd.. 2007.

3. "**The Trade marks Act 1999 (Bare Act with short comments)**", Universal Law Publishing Co. Ltd., 2005.
4. "**The Patents Act, 1970 (Bare Act with short comments), as amended by Patents (Amendment) Rules 2006 w.e.f. 5-5-2006**". Commercial law publishers (India) Pvt. Ltd., 2006.
5. Thomas T Gordon and Arthur S Cookfair, "**Patent Fundamentals for Scientist and Engineers**", CRC Press 1995.
6. Prabuddha Ganguli, "**Intellectual Property Rights**", TMH Publishing Co. Ltd, 2001