BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Department of Electrical and Electronics Engineering for Batch Admitted: 2008

Sem	HSS	BSC	ESC	PCC	PEC	IEC	Project	Seminar	Semester Total
I	02	9.5	13.5	-	-	-	-	-	**25**
II	02	9.5	13.5	-	-	-	-	-	**25**
III	-	08	-	17	-	-	-	-	**25**
IV	-	04	04	17	-	-	-	-	**25**
V	-	-	-	21	04	-	-	-	**25**
VI	-	-	-	17	08	-	-	-	**25**
VII	02	-	-	10	08	04	-	01	**25**
VIII	04	-	-	--	--	04	16	01	**25**
Course Total	**10**	**31**	**31**	**82**	**20**	**08**	**16**	**02**	**200**

HSS: Humanities

BSC: Basic Science Course

ESC: Engineering Science Course

PCC: Professional Core Course

PEC: Professional Elective Course

IEC: Institution Elective Course

BMS COLLEGE OF ENGINEERING, BANGALORE

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III SEMESTER

(Common to all branches except CSE / ISE)

Subject	ENGINEERING MATHEMATICS-III	Sub. Code	09MA3ICMAT
Credits	04	L-T-P	3-1-0

UNIT 1

Fourier series **08 Hours**

Periodic function, Dirichlet's conditions, statement of Fourier Theorem, Fourier coefficients, change of interval, Even and odd functions, Half range Fourier series, Complex Fourier series, Practical Harmonic analysis. **[6 L + 2 T]**

UNIT 2

Fourier Transforms **10 Hours**

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms, Convolution theorem (statement only), Parseval's identities. **[8 L + 2 T]**

UNIT 3

Partial Differential Equations **[12 Hours]**

Formation of Partial differential equations (PDE) by elimination of arbitrary constants or arbitrary functions, Solution of Lagrange's linear PDE, Solution of PDE by the Method of separation of variables, 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 **[9 L + 3 T]**

UNIT 4

Numerical methods – 1 **[10 Hours]**

Finite Difference operators: Forward differences, backward differences, Shift operator (no relations between the operators).

Interpolation: Newton - Gregory forward formula, Newton - Gregory backward formula. Newton's general interpolation formula, Lagrange's interpolation formula (without derivations), Inverse interpolation

Numerical Differentiation: Derivatives using forward and backward Newton Gregory formula.

Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, Weddle's rule (without derivations) **[8 L + 2 T]**

UNIT 5

Z- Transform **06 Hours**

Definition, Properties, Transforms of common functions, Inverse transform, solution of difference equations using Z -transforms. **[4 L + 2 T]**

Calculus of Variations **[06 Hours]**

Variation of function and functional, Euler-Lagrange's equation, variational problems, geodesics, Standard variational problems - minimal surface of revolution, hanging chain, Brachistochrone problem **[4 L + 2 T]**

Text Books:

1. **Higher Engineering Mathematics**, B.S. Grewal, 40th edition, Khanna Publishers
2. **Advanced Engineering Mathematics**, Erwin Kreyszig, 8th edition, Wiley Publications.

Reference Books:

1. **Higher Engineering Mathematics**, B.V. Ramana, Tata Mc. Graw Hill.
2. **Advanced Modern Engineering Mathematics**, Glyn James, 3rd edition, Pearson Education.

Subject	NETWORK ANALYSIS	Sub. Code	09ES3GCNAL
Credits	04	L-T-P	4-0-0

UNIT 1

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. **[08 Hours]**

UNIT 2

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

Resonant Circuits: Series and parallel resonance, frequency response of series and Parallel circuits, Q –factor, Bandwidth. **[10 Hours]**

UNIT 3

Network Theorems:

Superposition, Reciprocity, Millman's Thevinin's and Norton's theorems, Maximum Power transfer theorem. **[12 Hours]**

UNIT 4

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 & Applications

Review 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. **[12 Hours]**

UNIT 5

Two port network parameters

Definition of z, y, h and transmission parameters, modeling with these parameters, and relationship between parameters sets. **[10 Hours]**

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 Mc Graw 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	Analog Electronic Circuits	Sub. Code	09ES3GCAEC
Credits	05	L-T-P	4-0-1

UNIT 1

Semiconductor Diodes – Semiconductor diode, ideal versus practical, resistance levels, diode equivalent circuits, transition and diffusion capacitance, reverse recovery time, diode testing. **Diode Applications** – Introduction, load – line analysis, series diode configurations, parallel and series –parallel configurations, AND/OR gates, half wave rectification, full wave rectification, clippers, clampers, voltage multipliers. **[10 hours]**

UNIT 2

DC biasing of BJTS – Introduction, operating point, fixed bias circuit, emitter bias, voltage divider bias, dc bias with voltage feedback, miscellaneous bias configurations, design operations, transistor switching networks, PNP transistors, bias stabilization.

BJT AC Analysis – Introduction, amplification in the ac domain, BJT transistor modeling, r_e transistor model, the hybrid equivalent model, CE fixed bias, voltage divider bias, CE emitter bias, Complete hybrid equivalent model, determination of h-parameters, approximate conversion equations. **[11 hours]**

UNIT 3

Amplifiers in general- Cascaded systems, Darlington connections.

Power amplifiers – Introduction – definitions and amplifier types, series fed class A amplifier, transformer coupled class A amplifier, class B amplifier operation, class B amplifier circuits. Amplifier distortion, class C and class D amplifiers. **[11 hours]**

UNIT 4

Feedback and Oscillator Circuits– Feedback concepts, feedback connection types, practical feedback circuits, feedback amplifier – phase and frequency considerations, oscillator operation, phase shift oscillator, Wein bridge oscillator, tuned oscillator circuit, crystal oscillator, unijunction oscillator. **[10 hours]**

UNIT 5

BJT frequency response – Introduction, logarithms, decibels, general frequency considerations, low frequency analysis – Bode plot, BJT low frequency response, miller effect capacitance, BJT high frequency response.

FETs – Introduction, construction and characteristics of JFETs, transfer characteristics, important relationships, FET small signal model, JFET-Fixed Bias, self Bias and voltage divider bias configuration, JFET Common drain and common gate configurations.**[10 hours]**

LAB EXPERIMENTS- Clipping, clamping, half wave and full wave rectifiers, RC coupled amplifiers, Darlington emitter follower, RC phase shift oscillator, crystal oscillator, Hartley and Colpitts oscillator, voltage series feedback amplifier

Text Book:

1. **Electronic Devices and Circuit Theory** - Robert L.Boylestad and Louis Nashelsky - 9th edition - Pearson

Reference Books:

1. **Electronic Devices and Circuits** - Jacob Millman and Christos C. Halkias - TMH
2. **Electronic Devices and Circuits** - David A. Bell - PHI 4th edition

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Subject	Digital Electronics	Sub. Code	09ES3GCDEC
Credits	05	L-T-P	4-0-1

UNIT 1

Introduction: Review of Boolean algebra, logic gates

Simplification of Boolean functions: The Map Method, Two and Three Variable Maps, Four Variable Map, 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 **[10 Hours]**

UNIT 2

Combinational Logic Circuits: Introduction,Design Procedure,Adders, Subtractors, Code conversion (binary to gray, DCD to Excess-3)

Combinational Logic with MSI and LSI:

Introduction, Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, Multiplexers **[10 Hours]**

UNIT 3

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 **[10 Hours]**

UNIT 4

Sequential Logic Circuits: Registers, Counters, Design of Synchronous Counters **[10 Hours]**

UNIT 5

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 **[11 Hours]**

Lab Experiments:

Verification of gates, implementation of Boolean expressions using basic gates code conversion (binary to gray and BCD to Excess-3D) and universal gates, verify adders, subtracters, multiplexers, demultiplexers, comparators & code converter, Flip flops, counters, shift registers

Text Books:

1. **Digital logic and computer design**- Morris Mano, Prentice Hall
2. **Digital Principles and Design** - Donald Givone, Tata Mc Graw Hill

Reference Books:

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

BMS COLLEGE OF ENGINEERING, BANGALORE

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Subject	FIELD THEORY	Sub. Code	09ES3GCFTH
Credits	04	L-T-P	4-0-0

UNIT 1

Coulomb's Law, Electric Field Intensity (EFI): Experimental Law, EFI, due to Line Charge, Surface and Volume Charge

Electric Flux Density (EFD), Gauss' Law, Divergence: Electric Flux Density (EFD), Gauss' Law, Application, Divergence and Divergence Theorem **[10 Hours]**

UNIT 2

Energy and Potential: Energy spent in moving charge, Definition of Potential Difference (PD), PD due to Point Charge and System of Charge, Energy Density

Current and current density: Current and Current Density, Continuity of Current, Conductor, Properties, and Boundary Conditions **[10 Hours]**

UNIT 3

Dielectric and capacitance: Dielectric materials, boundary conditions, capacitance of different configuration

Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations, solution of Poisson's and Laplace for Single Variables **[10 Hours]**

UNIT 4

Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, curl, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials **[10 Hours]**

UNIT 5

Magnetic forces and Inductance: Force on a moving charge, Force on different current element, Magnetic Boundary Condition, Inductance and Mutual Inductance

Time varying fields and Maxwell's equations: Faraday's Law, Displacement Current, Maxwell's Equations in Point and Integral Form, Uniform plane waves, Wave equations , solution of wave equation, wave propagation through good dielectric, good conductor, skin depth, Poynting Theorem **[12 Hours]**

Text Books:

1. **Engineering Electromagnetics**, William J Hayt Jr. and John A Buck, Tata McGraw-Hill, 7th Edition, 2006

Reference Books:

1. **Electromagnetics with Applications**, John Krauss and Daniel A Fleisch, McGraw-Hill, 5th Edition, 1999.
2. **Field and wave electromagnetic**, David K Chary, Pearson Education Asia, Second Edition – 1989, Indian Reprint - 2001

BMS COLLEGE OF ENGINEERING, BANGALORE

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Subject	MEASUREMENT TECHNIQUES	Sub. Code	09ES3GCMST
Credits	03	L-T-P	3-0-0

UNIT 1

Fundamentals of Measurement: Introduction, 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. **[07 Hours]**

UNIT 2

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**[08 Hours]**

UNIT 3

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. **[08 Hours]**

UNIT 4

Transducers -I: Classification & Selection, Principle of operation of Thermocouples, Resistance Temperature Detectors, Thermistors, LVDT, Capacitive Transducers, Piezoelectric Transducers **[08 Hours]**

UNIT 5

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 **[08 Hours]**

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, Dhanpat Rai & Co., New Delhi.
2. **Electronic Instrumentation & Measurement**- by David A. Bell, 2/e, PHI Publications.

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IV SEMESTER

Subject	Engineering Mathematics – IV	Sub. Code	09MA4ICMAT
Credits	04	L-T-P	3-1-0

UNIT 1 **10 Hours**

Statistics: Curve fitting- Fitting of a straight line, parabola, curves of the $y = ae^{bx}$, $y = ab^{x}$, $y = ax^{b}$, Correlation and Regression **[4 L + 1 T]**

Probability – 1: Probability of an event, axiomatic definition, addition theorem, Conditional probability, multiplication theorem, Bayes's theorem. **[4 L + 1 T]**

UNIT 2 **[12 Hours]**

Probability – 2: Probability distributions: Random variables, discrete probability distributions – Binomial and Poisson distributions; Continuous probability distributions- Exponential and normal distributions

Joint Probability distributions: Case of discrete random variables, mathematical expectation, correlation, covariance

Markov Chain: Probability vectors, stochastic matrices, fixed points, regular stochastic matrices. Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states. **[9 L + 3 T]**

UNIT 3 **[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, Complex integration-Cauchy's theorem, Cauchy's integral formula, Taylor's and Laurent's series, Singular points, poles, residues, residue theorem **[8 L + 2 T]**

UNIT 4 **[03 Hours]**

Complex Analysis- 2:
$w = z^2$, $w = e^z$, $w = z + \left(a^2/z\right)$ Transformations: Bilinear transformations**.** **[2 L + 1 T]**

Series Solution Of Differential Equations **07 hours**

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 **[6 L + 1 T]**

UNIT 5 **[10 Hours]**

Numerical Methods – 2: Algebraic and Transcendental Equations: Regula falsi method, Newton Raphson method, Numerical solutions of ordinary differential equations: Taylor's series method modified Euler's method, Runge-Kutta 4th order method, Milne's method and Adam's - Bashforth method (No derivations of formulae) **[3 L + 2T]**

Matrices: Echelon form of a matrix, Rank of a matrix by elementary row transformations, Consistency of system of linear equations, Gauss elimination method, Gauss – Seidel method, Characteristic values and Characteristic vectors of matrices, Computation of largest eigen value and eigen vector using Rayleigh's power method. **[3 L + 2 T]**

Text Books:

1. **Advanced Engineering Mathematics**, Erwin Kreyszig, 8th edition, Wiley Publications.
2. **Higher Engineering Mathematics**, B.S. Grewal, 40th edition, Khanna Publishers.

Reference Books:

1. **Advanced Modern Engineering Mathematics**, Glyn James, 3rd edition, Pearson Education.
2. **Higher Engineering Mathematics**, B.V. Ramana, 5th reprint 2008, Tata Mc. Graw Hill.
3. **Probability and Statistics**, Murry R Spiegel, John Schiller, Alu Srinivasan, 2nd edition, Schaumn's outline series
4. **Introductory methods in Numerical Analysis,** S.S. Sastry, 4th edition, Prentice Hall of India

Subject	OP AMPS and Linear ICS	Sub. Code	9ES4GCLIC
Credits	05	L-T-P	4-0-1

UNIT 1

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 and AC Amplifiers and its frequency response: Biasing operational Amplifiers, Direct coupled voltage followers, Direct coupled non-inverting amplifiers, Direct coupled inverting amplifiers, summing amplifiers, Difference amplifiers **[11 Hours]**

UNIT 2

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 **[11 Hours]**

UNIT 3

OP-AMP Non Linear Circuits: op-amp and switching circuits, zero 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 **[10 Hours]**

UNIT-4:

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. **[10 Hours]**

UNIT-5:

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

A/D and D/A Converter: Introduction, Basic DAC Techniques, A-D Converters, DAC / ADC Specifications. **[10 Hours]**

Lab Experiments:

Inverting amplifier, non-inverting amplifier, summing amplifier and voltage follower, precision half-wave and full wave rectifier, 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, 555 timer as a stable and monostable multiviberator, D/A convertor and A/D convertor.

Text Books:

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

Reference Books:

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

Subject	Microprocessor	Sub. Code	09ES4GCMPR
Credits	04	L-T-P	3-0-1

UNIT 1

Introduction, Microprocessor based computer system, Architecture of 8086 Microprocessor, Pin functions, Clock generator, and Minimum/Maximum mode of operation. **[08 Hours]**

UNIT 2

Read /Write Timing diagrams, Assembly level programming of 8086, 8086 instruction set, addressing modes, Assembler directives, Programming examples. **[08 Hours]**

UNIT 3

Stacks, Procedures and Interrupts, Interfacing 8086 with Memory devices **[08 Hours]**

UNIT 4

Interfacing 8086 with I/O devices, 8255 PPI device, modes of operation, Interfacing, Keyboard, display, seven segment display, ADC, DAC, Stepper motor and Printer interfacing using 8255 **[08 Hours]**

UNIT 5

Programmable Interval Timer: modes of operation of 8253 and interfacing, 8087 Numeric data processor and interfacing, 8087 Data types **[07 Hours]**

Lab Experiments

Data and address transfer operations, unsigned and signed arithmetic operations using instructions for add/sub/mul/div, logical operations, linear search and sorting, code conversion programs using procedures, interfacing I/O devices like DSC, stepper motors, Keyboard, 7 segment display to 8086 using 8255 PPI, realization of ALU, Counters and multiplexer using 8086

Text Books:

1. **Advanced Microprocessor and Peripherals-** A.K.Ray and K.M. Bhurchandi, Tata McGraw Hill
2. **Microcomputer systems 8086/8088 family, Architecture, Programming and Design -** Yu-Cheng Liu & Glenn A Gibson, 2nd ed, July 2003, PHI

Reference Books:

1. **Microprocessor and Interfacing, Programming & Hardware-** Douglas V Hall, 2nd ed, TMH
2. **Microprocessor Architecture, Programming and Applications with the 8085-** Ramesh S Gaonkar, 4th edition, Penram International.

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Subject	SIGNALS AND SYSTEMS	Sub. Code	09ES4GCSAS
Credits	04	L-T-P	4-0-0

UNIT 1

Introduction: Signal definition, signal transformation, and signal classification, elementary signals. System definition, system classification, system properties **[10 Hours]**

UNIT 2

Frequency domain representation of non-periodic signals: Fourier representation of continuous time non-periodic signals: Continuous-time Fourier transform (FT), Fourier representation of discrete time non-periodic signals: Discrete-time Fourier transform (DTFT); Relating the FT and the DTFT **[10 Hours]**

UNIT 3

Frequency domain representation of periodic signals: Fourier representation of continuous time periodic signals: Continuous time Fourier series (FS); Fourier representation of discrete time periodic signals: Discrete-time Fourier series (DTFS); Relating the FT and the FS, Relating the FT to the DTFS & DTFT **[10 Hours]**

UNIT 4

Time domain analysis of LTI systems: Definition of LTI systems, Continuous time systems and Discrete time systems: Definition of impulse response, development of convolution integral, convolution sum, methods of evaluating the convolution sum & convolution integral, properties of impulse response **[11 Hours]**

UNIT 5

Representation of LTI systems: Continuous time LTI system representation: Time domain: impulse response, Differential equation, Block diagram; Frequency domain: frequency response; Laplace transform domain: – transfer function, pole-zero plot relating the time, frequency and the transform domain (State-space representation not included)

Discrete time LTI system representation: Time domain: – impulse response, Difference equation, Block diagram; Frequency domain: – frequency response; Z- transform domain: – transfer function, pole-zero plot, Relating the time, frequency and the transform domain (State-space representation not included) **[11 Hours]**

Text Books:

1. **Signals and Systems-**Simon Haykin and Barry Van Veen, John Wiley & Sons, 2nd ed.
2. **Signals and Systems-** H.P Hsu, Schaums Outline series, TMH.

Reference Books:

1. **Signals and Systems:** Analysis of signals through linear systems- Michel J Roberts, TMH, 2003.
2. **Signals and Systems-**Alan V Oppenheim, Alan S Willsky and S.Hamid Nawab-Pearson Education Asia, 2nd ed 1997, Indian reprint 2002.

Subject	Control Systems	Sub. Code	09ES4GCCST
Credits	04	L-T-P	4-0-0

UNIT 1

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) **[12 Hours]**

UNIT 2

Time Response Analysis Of Control Systems: Step response of first order, second order systems, response specification, steady state error and error constants **[10 Hours]**

UNIT 3

Stability Analysis: Concept of stability, RH criterion, applications of RH criterion with limitations, Nyquist plot, Polar plots, Stability Analysis using Nyquist criterion **[10 Hours]**

UNIT 4

Root Locus Technique: Introduction to root locus concepts, Construction rules, Analysis of stability by root locus plot **[10 Hours]**

UNIT 5

Frequency Response Analysis: Bode plots, Relative stability, Frequency domain specification **[10 Hours]**

Text Books:

1. **Control Engineering** by Nagrath & Gopal, New Age International Publishers

Reference Books:

1. **Modern control Engineering** - Ogata, Prentice Hall
2. **Automatic Control Systems** - B.C Kuo, John Wiley and Sons

Subject	Fundamentals of HDL	Sub. Code	09ES4GCHDL
Credits	04	L-T-P	3-0-1

UNIT 1

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 **[7 Hours]**

UNIT 2

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 **[8 Hours]**

UNIT 3

Structural Descriptions: Highlights of structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements **[8 Hours]**

UNIT 4

Procedures And Functions: Procedures, Tasks, and Functions: Highlights of Procedures, tasks, and Functions, Procedures and tasks, Functions, Advanced HDL Descriptions: File Processing, Examples of File processing **[8 Hours]**

UNIT 5

Synthesis Basics: Highlights of Synthesis, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain **[8 Hours]**

Lab Experiments

Combinational logic circuits, sequential circuits using data flow (simulation and implementing using FPGA/CPLD) sequential descriptions & structural descriptions, interfacing experiments: stepper motor, dc motor, relay, waveform generation

Text Books:

1. **HDL Programming (VHDL and Verilog)-** Nazeih M.Botros- Dreamtech Press (Available through John Wiley – India and Thomson Learning), 2006 Edition

Reference Books:

1. **Verilog HDL** -Samir Palnitkar, Pearson Education
2. **VHDL** -Douglas Perry,TMH
3. **Fundamentals of Digital Logic with Verilog Design**-Stephen Brown, TMH
4. **Circuit Design with VHDL**-Volnei A.Pedroni, PHI

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V SEMESTER

Subject	Transmission and Distribution	Sub. Code	10EE5DCTND
Credits	04	L-T-P	4-0-0

UNIT 1

a:Typical Transmission & Distribution Systems Scheme- Standard voltages for transmission. Advantage of high voltage transmission. Feeders, distributors & service mains.

b:Overhead Transmission Lines- sag calculation in conductors a) suspended on level supports b) support at different levels. Effect of wind & ice tension & sag at erection. Stringing chart. **[10 Hours]**

UNIT 2

a:Insulators- Types, potential distribution over a string of suspension insulators. String efficiency & methods of increasing strings efficiency, testing of insulators.

b: Distribution- radial & ring main systems, ac to dc distribution: calculation for concentrated loads and uniform loading **[10 Hours]**

UNIT 3

Underground Cables- Types, material used, insulation resistance, thermal rating of cables, charging current, grading of cables, capacitance grading & inter sheath grading, testing of cables**.** **[10 Hours]**

UNIT 4

Line Parameters: calculation of inductance of single phase, 3phase lines with equilateral & unsymmetrical spacing. Capacitance-calculation for two wires & three phase lines, capacitance calculation for two wire three-phase line with equilateral & unsymmetrical spacing. **[11 Hours]**

UNIT 5

Performance Of Power Transmission Lines- Short Transmission-lines, medium Transmission-lines, nominal T method, π method and long transmission lines, ABCD constants of Transmission lines**.** **[11 Hours]**

TEXT BOOKS:

1. **Transmission and Distribution –**J.B.Gupta, Kataria Publishers**.**
2. **Electrical Power Systems-** C. L. Wadhwa, Wiley Eastern.

REFERENCE BOOKS:

1. **Elements of Power System Analysis -** W.D. Stevenson, Mc. Graw - Hill. Comp. Ltd.
2. **Electric power generation, Transmission & Distribution-** Dr. S. N. Singh, PHI, 2007.
3. **Transmission & Distribution Hand Book -** Westing House Corporation**.**
4. **Electrical Power Transmission and Distribution -** S.Sivanagaraju and S.Satyanarayana, Pearson Education Private Limited.P.H.I., New Delhi.

Subject	**Fundamentals of Digital Signal Processing**	**Sub. Code**	**10EE5DCFDP**
Credits	**04**	**L-T-P**	**3-1-0**

UNIT 1

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.

(9L+2T) = 11 Hours

UNIT 2

(a) Circular convolution in the time domain ,use of tabular arrays and circular arrays, Use of DFT in linear filtering, linear convolution of two finite duration sequences, overlap add and save methods**.** Relation between DFT and other transforms.

(4L+1T)=5 Hours

(b) 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. **(5L+1T)= 6 Hours**

UNIT 3

(a) 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).

(b) Introduction to realization of digital systems, block diagrams, representation, Realization of Infinite Impulse Response (IIR) systems : direct form, parallel form, cascade form.
Realization of Finite Impulse Response (FIR) systems : Direct Form, Linear Phase Form**.** **(7L+4T) = 11 Hours**

UNIT 4

Introduction to IIR filters, impulse invariant & bilinear transformations, Design of analog filters: Design of Digital filters: Butterworth and Chebyshev. Frequency transformations. **(6L+2T) = 8 Hours**

UNIT 5

(a) Introduction to FIR filters, Frequency response of ideal digital low pass filter, high pass filter, frequency sampling technique of designing FIR filters.

(b) Windowing, Design of FIR filters using rectangular , triangular, Hamming, Hanning and Blackman window. Gibbs phenomenon (qualitative discussion only), comparison between IIR and FIR filters**.** **(8L+3T)=11 Hours**

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	Transformers & Induction Machines	Sub. Code	10EE5DCTIM
Credits	05	L-T-P	4-0-1

UNIT 1

(a) Basic Concepts: Principle of transformer action for voltage transformation. Constructional details of shell type and core type single-phase transformers.

(b) Single-phase Transformers: Concept of ideal transformer. Equation for E.M.F. induced in the two windings. Voltage transformation ratio. Ideal transformer on no-load and loaded condition with corresponding phasor diagrams. Concept of M.M.F. balance in the magnetic circuit of an ideal transformer. Current transformation ratio. Concept of referring impedance connected on one side of ideal transformer to the other side. Practical transformer – how it deviates from the ideal transformer. Development of exact equivalent circuit of a practical transformer – visualization of a practical transformer as an ideal transformer combined with imperfections of electric and magnetic circuits. Approximate equivalent circuit of a practical transformer. **[11 Hours]**

UNIT 2

Phasor diagram of a practical transformer for both no-load and loaded conditions. Losses, power and all-day efficiency, regulation. Testing of transformers — O.C. test, S.C. test and predetermination of efficiency and regulation. Sumpner's test. Parallel operation — need, conditions to be satisfied for parallel operation. Load sharing. **[10 Hours]**

UNIT 3

Three-phase Transformers: All types of three-phase transformer connections . Choice of connections. Bank of single-phase transformers for three-phase operation. Phase conversion using transformers. Scott connection for three-phase to two-phase conversion. Labeling of three-phase transformer terminals. **[9 Hours]**

UNIT 4

Basic Concepts of Induction Machines: Concept of rotating magnetic field. Operating principle, construction, classification and types — single-phase, three-phase, squirrel-cage, slip-ring,

Three-phase Induction Motor: Phasor diagram of induction motor on no-load and loaded conditions. Visualization of a three-phase induction motor as a generalized transformer with a rotating secondary and obtaining its equivalent circuit. Different kinds of power losses in an induction motor. Efficiency. Performance evaluation — output power, torque, efficiency, current and power factor. **[10 Hours]**

UNIT 5

(a) Torque-slip characteristics covering motoring, generating and braking regions of operation. Induction generator. No-load and blocked rotor tests. Circle diagram and therefrom performance evaluation of the motor. Cogging and crawling. Equivalent circuit and performance of double-cage and deep-bar motors. —

(b) Starting and Control of Three-phase Induction Motor, Need for starter. DOL, Y-Delta and auto-transformer starting. Rotor resistance starting.. Speed control — voltage, frequency, and rotor resistance variations.

(c) Single-phase Induction Motor: Double revolving field theory and principle of operation. Types of single-phase induction motors: split-phase, capacitor start, shaded pole motors. **[12 Hours]**

Lab Experiments

Test on single phase transformer: OC, SC test and pre-determination of efficiency and regulation, Load test and performance evaluation , Sumpner's test, polarity test, Parallel operation, Three phase transformer connections and scott connection. Tests on three phase induction motor. Load test, OC and SC tests and development of equivalent circuit and performance evaluation through Circle diagram, Speed control of 3-phase induction motor. Load test on single phase induction motor, OC and SC test and development of equivalent circuit.

TEXT BOOKS:

1. **Theory and performance of Electrical Machines** –J.B.Gupta., S.K.Kataria and sons – New Delhi.
2. **Transformers and Induction Machines,** Dr.A S AravindMurthy, Pearson Publications.

REFERENCES :

1. **"Electric Machines**", I. J. Nagrath and D. P. Kothari, 3rd Edition, T.M.H., Education Pvt Ltd.., New Delhi

Subject	Electrical Power Generation	Sub. Code	10EE5DCEPG
Credits	03	L-T-P	3-0-0

UNIT 1

SOURCES OF ELECTRICAL POWER: Conventional and nonconventional sources: Introduction, environmental impact, prospects , development , applications, recent advances in energy resources (block diagram approach only). Concept of co-generation. Combined heat and power distributed generation **[8 Hours]**

UNIT 2

(a) NUCLEAR POWER STATION: Introduction. Adverse effects of fossil fuels. Pros and cons of nuclear power generation. Selection of site, cost, components of reactors. Description of fuel sources. Safety of nuclear power reactor.

(b) Diesel electric plants. Gas turbine plants. Mini, micro, and bio generation. Concept of distributed generation. **[8 Hours]**

UNIT 3

(a) HYDRO POWER GENERATION: Selection of site. Classification of hydro-electric plants. General arrangement and operation. Hydroelectric plant power station structure and control**.**

(b) THERMAL POWER GENERATION: Introduction. Main parts of a thermal power plant.Working.Plant layout. **[8 Hours]**

UNIT 4

(a) ECONOMICS ASPECTS: Introduction. Terms commonly used in system operation. Diversity factor, load factor, plant capacity factor, plant use factor, plant utilization factor, loss factor, load duration curve.

(b) Power factor improvement and tariffs. Energy-load curve **[8 Hours]**

UNIT 5

(a) Substations: Introduction. Types. Bus bar arrangement. Schemes. Location. Substation equipment. Reactors and capacitors.

(b) Current limiting reactors. Symmetric short circuit MVA calculations.**[7 Hours]**

TEXT BOOKS:

1. **Power System Engineering**, A. Chakrabarti, M. L. Soni, and P.V. Gupta, Dhanpat Rai and Co., New Delhi.
2. **Elements of Power System Design**, M. V. Deshpande, A. H. Wheeler and Co.

REFERENCES:

1. **Electric Power Generation, Transmission and Distribution,** Dr. S. N. Singh, P.H.I., New Delhi.

Subject	Microcontrollers	Sub. Code	10ES5GCMCS
Credits	04	L-T-P	3-0-1

UNIT 1

Introduction to Microcontrollers:

Microprocessors and microcontroller. Introduction, Difference between Microprocessors and Microcontrollers. 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. **[8 Hours]**

UNIT 2

Assembly Language Programming in 8051

Addressing Modes and Instruction set: Introduction, Addressing modes, Data transfer instructions, Example programs, Arithmetic instructions, Logical instructions, Example programs, JUMP and CALL Program range, Jumps, calls and Subroutines, Returns, Example Programs . **[8 Hours]**

UNIT 3

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. **[8 Hours]**

UNIT 4

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. **[8 Hours]**

UNIT 5

8051 Interfacing and Applications:

Interfacing 8051 to LCD, Keyboard, DAC, ADC, Stepper motor, DC motor interfacing and PWM. **[7 Hours]**

Lab Experiments

a. Data Transfer , Logical-Byte/Bit manipulations ,Jump and Subroutine Calls using Assembly-Language Programming
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 7 segment interface.

The Experiments will be implemented using 'Keil' software with Embedded IDE. For interfacing programs 8051 target board is used.

TEXT BOOKS:

1. **The 8051 Microcontroller Architecture, Programming & Applications,** Kenneth J. Ayala 2e, Thomson Learning 2005
2. **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:

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

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Subject	Electrical Measurements and Control Systems lab	Sub. Code	10EE5DCMCL
Credits	01	L-T-P	0-0-1

1. To measure (a) Medium resistance by Wheatstone bridge, (b) Low resistance by Kelvin's Double Bridge. (c) High Resistance by Megger.
2. Measurement of Inductance and Capacitance by (a) A-V-W Method (b) Three Voltmeter Method.
3. Measurement of Inductance and Capacitance using A.C Bridges
4. Calibration of Single Phase Energymeter
5. To measure the variation in speed of a dc servomotor in terms of voltage and frequency using an optical sensor and a frequency to voltage converter.
6. Using MATLAB, to simulate a typical second order system and to determine the step response and to evaluate (a) the time- domain specifications for different values of ζ (b) the effect of change in ζ on pole location and stability
7. (a) Using MATLAB, to design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response.

   (b) Verify experimentally the frequency response of the above lead compensating network.
8. (a) Using MATLAB, to design a RC lag compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response

   (b) Verify experimentally the frequency response of the above lag compensating network.
9. To study the effect of P, PI, PD and PID controller on the step response of a feedback control system. Verify the same by simulation using MATLAB/SIMULINK.
10. Using MATLAB comparative study of Bode Plots and Root locus w.r.t. Stability.

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VI SEMESTER

Subject	POWER SYSTEM ANALYSIS	Sub. Code	10EE6DCPSA
Credits	04	L-T-P	3-1-0

UNIT 1 & 2

Representation Of Power System Components: Circuit models of Transmission line, Synchronous machines, Transformer and load. One line diagram, impedance and reactance diagram. Per unit system, per unit impedance. Single line diagram of power system, Formation of Y-bus and Z-bus, Matrix partitioning technique.

Symmetrical 3 - Phase Faults: Transients on a transmission line, Short-Circuit currents and the reactance of synchronous machines on load and on no load**.**

[15L+5T]=20 Hours

UNIT 3 & 4

Symmetrical Components: Analysis of unbalanced load against balanced Three-phase supply, neutral shift, Resolution of unbalanced phasors into their symmetrical components, Phase shift of symmetrical components in star-delta transformer bank, Power in terms of symmetrical components, Analysis of balanced and unbalanced loads against unbalanced 3 phase supply, Sequence impedances and networks of power system elements (alternator, transformer and transmission line) Sequence networks of power systems. **[14L+4T]= 18 Hours**

UNIT 5

Unsymmetrical Faults: L-G, L-L, L-L-G faults on an unbalanced alternator with and without fault impedance. Unsymmetrical faults on a power system with and without fault impedance. Open conductor faults in power system. **[10L+4T]= 14 Hours**

TEXT BOOKS:

1. **Elements of Power System Analysis,** W.D.Stevenson, TMH.
2. **Modern Power System Analysis,** I. J. Nagrath and D.P.Kothari, TMH, New Delhi.

REFERENCE BOOKS:

1. **Power System Analysis,** Hadi Sadat, TMH
2. **Power system Analysis,** R.Bergen, and Vijay Vittal, Pearson publications, second edition**.**
3. **Computer Aided Power system analysis,** G.L., Kusic, PHI.
4. **Power System Analysis,** W.D. Stevenson & Grainger, TMH

Subject	DC MACHINES AND SYNCHRONOUS MACHINES	Sub. Code	10EE6DCDSM
Credits	05	L-T-P	4-0-1

UNIT 1

a) DC Generator- Review : Classification of DC generator, types of armature winding, EMF equation, armature reaction, commutation, No load & load characteristics, use of interpoles & compensating winding (only qualitative analysis).

b) DC Motors- Review : Classification, Back EMF equation, Torque equation, Characteristics of shunt, series & compound motors,
Speed control of shunt, series & compound motors, losses in DC machines (both generator and motor) **[11 Hours]**

UNIT 2

Testing of DC Machines and Applications, Power flow diagrams ,direct & indirect methods of testing of DC machines, Swinburne's test, Hopkinson's test, Retardation test, applications of DC motors, **[10 Hours]**

Unit 3

Synchronous Machines- Basic principle of operation, construction of salient & non-salient pole synchronous machines, generated EMF, effect of distribution of winding and use of chorded coils.

Voltage Regulation: Voltage regulation by EMF, MMF, Potier Triangle method, voltage regulation of salient machines. **[12 Hours]**

UNIT 4

Synchronisation: Concept, necessity, conditions, Synchronizing to infinite bus bars, parallel operation of alternators. Operating characteristics, power angle characteristics excluding armature resistance, operation for fixed power input and variable excitation and vice-versa for both generating and motoring modes **[10 Hours]**

UNIT 5

V curves of synchronous machines, power flow equations including armature resistance, capability curves of synchronous generators, hunting in synchronous machines, damper winding, starting methods. **[9 Hours]**

Lab Experiments:

Load characteristics of a D.C. generators, Load test on a DC motor, Swinburne's Test, Hopkinson's Test, Retardation test, Speed control of DC motor by armature voltage control, flux control, Ward Leonard method, Voltage regulation of a non-

salient pole alternator by EMF, MMF method and ZPF method. Slip test. Synchronization of alternator in parallel with the bus-bars. V curves of a synchronous motor.

TEXT BOOKS:

1. **Theory and performance of Electrical Machines,** J.B.Gupta, S.K.Kataria and sons –New Delhi.
2. **DC and Synchronous Machines,** Dr. A S Aravind Murthy, Pearson Publications.

REFERENCES : .

1. **Electric Machines,** I. J. Nagrath and D. P. Kothari, 3rd Edition, T.M.H., Education Pvt Ltd.., New Delhi

Subject	POWER ELECTRONICS	Sub. Code	10EE6DCPEN
Credits	05	L-T-P	4-0-1

UNIT 1

Introduction, Power Semiconductor Devices: Applications of Power Electronics, Power semiconductor devices, Control Characteristics. Types of power electronic circuits. Peripheral effects. Power Transistors: Power BJT's – switching characteristics, switching limits. Power MOSFET's – switching characteristics, gate drive. IGBT's, di/dt and dv/dt limitations. **[10 Hours]**

UNIT 2

Thyristors: Introduction, characteristics. Two Transistor Model. Turn-on and turn-off. di/dt and dv/dt protection. Thyristor types. Thyristor firing circuits. Simple design of firing circuits using UJT. Commutation Techniques: Introduction. Natural Commutation. Forced commutation: self commutation and complementary commutation**.** **[10 Hours]**

Unit 3

Controlled Rectifiers: Introduction. Principle of phase controlled converter operation. Single- phase semi-converters. Full converters. Three-phase half-wave converters. Three-phase full-wave converters. **[10 Hours]**

UNIT 4

Inverters: Introduction. Principle of operation. Performance parameters. Single-phase bridge inverters. Three phase inverters. Voltage control of single-phase inverters – single pulse width, multiple pulse width, and sinusoidal pulse width modulation. Current source inverters. **[11 Hours]**

UNIT 5

DC Choppers: Introduction. Principle of step-down and step-up chopper. Performance parameters. Chopper classification. AC Voltage Controllers: Introduction. Principle of ON-OFF and phase control. Single-phase bidirectional controllers with resistive and inductive loads. **[11 Hours]**

Lab Experiments

1. Static characteristics of SCR, MOSFET and IGBT.
2. SCR turn-on circuit using synchronized UJT relaxation oscillator.
3. SCR Digital triggering circuit for a single-phase controlled rectifier OR A.C. voltage controller.
4. Single-phase fully controlled convertor with *R* and *R-L* loads (CCM mode only).
5. A.C. voltage controller using TRIAC and DIAC combination connected to *R* and *R-L* loads.
6. Speed control of a separately excited D.C. motor using an IGBT or MOSFET based chopper.
7. Simulation Study of Power Electronic Circuits (Controlled Rectifiers or Choppers)
8. MOSFET OR IGBT based single-phase full-bridge inverter connected to R load.

TEXT BOOK:

1. **Power Electronics,** M.H.Rashid 2nd Edition, P.H.I. /Pearson, New Delhi, 2002.
2. **Power Electronics – Converters, Applications and Design,** Ned Mohan, Tore M. Undeland, and William P. Robins, Third Edition, John Wiley and Sons.

REFERENCES

1. **Thyristorised Power Controllers,** G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, New Age International Publishers.
2. **Power Electronics,** M.D. Singh and Khanchandani K.B, T.M.H., 2001.
3. **Power Electronics,** Cyril Lander, 3rd Edition, McGraw-Hill.

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Subject	MODERN CONTROL THEORY	Sub. Code	10EE6DCMCT
Credits	03	L-T-P	3-0-0

UNIT 1

State Variable Analysis and Design:

Introduction, concept of state, state variables and state model, state modeling of linear systems, linearization of state equations. State space representation using physical variables, phase variables & canonical variables. **[8 Hours]**

UNIT 2

Derivation of transfer function from state model, Eigen values, Eigen vectors, generalized Eigen vectors. Solution of state equation, state transition matrix and its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method**.** **[8 Hours]**

Unit 3

Concept of controllability & observability, methods of determining the same, Effect of Pole-Zero Cancellation. Duality**.** **[7 Hours]**

UNIT 4

Pole Placement Techniques:

Stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement, state regulator design, and design of state observer**.** **[8 Hours]**

UNIT 5

Non-linear Systems:

Introduction, behavior of non-linear system, common physical non linearity-saturation, friction, backlash, dead zone, relay, multi variable non-linearity. Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories. **[8 Hours]**

Text Books:

1. **Digital control & state variable methods,** M. Gopal, 2nd edition, THM Hill 2003
2. **Control system Engineering,** I. J. Nagarath & M. Gopal, 3rd edition, New Age International (P) Ltd.

Reference Books:

1. **State Space Analysis of Control Systems,** Katsuhiko Ogata, Prentice Hall Inc
2. **Automatic Control Systems,** Benjamin C. Kuo & Farid Golnaraghi, 8th edition, John Wiley & Sons 2003.
3. **Modern Control Engineering,** Katsuhiko Ogata, PHI 2003
4. **Modern control systems,** Dorf & Bishop, Pearson education, 1998

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VII SEMESTER

Subject	HUMAN RESOURCE MANAGEMENT	Sub. Code	11HS7GCHRM
Credits	02	L-T-P	2-0-0

UNIT 1

Management **[04 Hours]**

Understanding the Nature and Scope of HRM, Context of HRM.

UNIT 2

Planning **[05 Hours]**

Human Resource Planning, Analyzing Work and Designing Jobs

UNIT 3

Recruitment **[05 Hours]**

Recruiting Human Resources, Selecting Human Resources.

UNIT 4

Training **[06 Hours**]

Training, Development and Career Management, Appraising and Managing Performance, Managing Basic Remuneration.

UNIT 5

Entrepreneur **[06 Hours]**

Meaning of Entrepreneur; Functions of an Entrepreneur, Types of Entrepreneur, Development of Entrepreneurship; Intrapreneur - an emerging Class.

TEXT BOOK:

1. **Human Resource Management**: K. Ashwathappa, Text and Cases. Fifth Edition (2008) Tata McGraw-Hill Publishing Company Ltd., New Delhi.

REFERENCE BOOK:

1. **Human Resource Management,** Gary Dessler, Tenth Edition (Indian subcontinent adaptation 2008), Pearson Education, Inc.
2. **Dynamics of Entrepreneurial Development & Management**, Vasant Desai Himalaya Publishing House**.**

Subject	COMPUTER TECHNIQUES IN POWER SYSTEM ANALYSIS	Sub. Code	11EE7DCCTP
Credits	05	L-T-P	4-0-1

UNIT 1 **[10 hours]**

Network Formulation, representation of transmission lines and transformers with off nominal turns ratio, Formation of Y_{BUS} by inspection. Bus incidence matrix, Primitive network – impedance form and admittance form, Y-bus by singular transformation, Z bus building algorithm (without mutuals).

UNIT 2 **[10 hours]**

Power flow equations, Classification of buses, Operating constraints, Data for load flow; Gauss-Seidel Method – Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence.

UNIT 3 **[10 hours]**

Newton-Raphson Method – Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only), Algorithm for Fast Decoupled load flow method, Comparison of Load Flow Methods.

UNIT 4 **[12 hours]**

Economic Operation of Power System: Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Economic Dispatch including transmission losses, Derivation of transmission loss formula, iterative technique for solution of economic dispatch with losses. **[10 hours]**

UNIT 5

Stability Studies: Steady state and transient stability, Rotor dynamics and the swing equation, Power angle equation for salient and non-salient pole machines, Equal area criterion for transient stability evaluation and its applications, Numerical solution of Swing Equation – Point-by-point method

Lab Experiments

1. Y Bus formation for power systems with and without mutual coupling, by singular transformation and inspection method.
2. Determination of bus currents, bus power and line flow for a specified system voltage (Bus) Profile
3. Formation of z-bus, using z-bus building Algorithm without mutual coupling.
4. ABCD parameters:
   a. Formation for symmetric π and T configuration.
   b. Verification of AD-BC=1

c. Determination of efficiency and regulation

5. To determine (i) Swing curve (ii) critical clearing time, for a single m/c infinite bus system with a double circuit line, for a 3- phase fault on one of the lines. Simulation for the above to be conducted with variations in inertia constant/line parameters /fault location/clearing time/pre-fault electrical output.
6. Formation of Jacobian in polar coordinates.
7. To perform load flow using Gauss- Seidel method (only PQ bus)
8. Load flow analysis using Gauss Siedel method, NR method, Fast decoupled flow method for both PQ and PV buses.
9. Optimal Generator Scheduling for Thermal power plants.
10. To determine fault currents and voltages in a single transmission line system with star-delta transformers at a specified location for SLGF, DLGF.

Note: Write programs for Experiments 1-8, use Simulation Package for Experiments 9-10

Text Books:

1. **Computer Methods in Power System Analysis-** Stagg, G. W., and EI-Abiad, A. H.- McGraw Hill International Student Edition. 1968
2. **Computer Techniques in Power System Analysis**- Pai, M. A- TMH, 2nd edition, 2006.
3. **Modern Power System Analysis-** Nagrath, I. J., and Kothari, D. P., -TMH, 2003.
4. **Power System Analysis, W**.D Stevenson, TMH
5. **Computer Techniques and Models in Power Systems, K**. Uma Rao, I.K International.

Reference Books:

1. **Advanced Power System Analysis and Dynamics**- Singh, L. P., New Age International (P) Ltd, New Delhi, 2001.
2. **Power System Analysis-** Haadi Sadat, -TMH, 2nd , 12th reprint, 2007

Choice : Unit II & IV

BMS COLLEGE OF ENGINEERING, BANGALORE

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Subject	SWITCHGEAR AND PROTECTION	Sub. Code	11EE7DCSGP
Credits	05	L-T-P	4-0-1

UNIT 1 **[10 hours]**

Switches and Fuses: Isolating switch, load breaking switch, Fuse law, cut -off characteristics, Time current characteristics, fuse material, HRC fuse, liquid fuse, Application of fuse.

Protective Relaying: Requirement of Protective Relaying, Zones of protection, primary and backup protection, Essential qualities of Protective Relaying, Classification of Protective Relays.

UNIT 2 **[10 hours]**

Induction Type Relay: Non-directional and directional over current relays, IDMT and Directional characteristics. Differential relay – Principle of operation, percentage differential relay, bias characteristics, distance relay, Impedance relay, Reactance relay, Mho relay, Buchholz relay, Negative Sequence relay. **[10 hours]**

UNIT 3

Principles of Circuit Breakers: Principles of AC Circuit breaking, Initiation of arc, maintenance of arc, Arc interruption - high resistance and low resistance interruption, Arc interruption theories – slepian's theory and energy balance theory, Re striking voltage, recovery voltage, Rate of rise of Re striking voltage, Rating of Circuit breakers

Circuits Breakers: Air Circuit breakers – Air break and Air blast Circuit breakers, SF6 breakers, Vacuum Circuit breakers, Construction, principle of operation, Advantages and disadvantages of different types of Circuit breakers.

UNIT 4 **[10 hours]**

Static Relays: Introduction, Basic construction, Classification, Basic Circuits, Smoothing Circuits, Voltage regulation, square wave Generator, Time delay Circuits, Level Detectors, Summation device, Sampling Circuits, Zero crossing detector, output devices

UNIT 5 **[12 hours]**

Comparators: Replica impedance, Mixing Transformers, General equation of phase and Amplitude, Comparators, Realization of ohm, mho, Impedance characteristics, Duality principle, Static amplifier comparator – Rectifier bridge circulations current type, static phase comparator coincidence circuits type Rectifier phase comparator.

Lab Experiments

1. Fuses
2. Overcurrent protection using Electromagnetic relays
3. Over-Voltage protection using Electromagnetic relays
4. Under-Voltage protection using Electromagnetic relays
5. Over-Voltage protection using Static relays
6. Under-Voltage protection using Static relays
7. Motor Protection relay
8. Operation of Circuit Breaker using PSCAD
9. Capacitive Switching using PSCAD
10. Detection of various types of faults in a simple AC system using PSCAD

TEXT BOOKS:

1. **Switchgear & Protection**- Sunil S.Rao -Khanna Publishers.
2. **Power System Protection & Switchgear**- Badriram & Viswa Kharma -TMH.
3. **Power System Protection, Static Relays with Microprocessor applications-** T.S. Madava Rao, TMH, Second editon, 2004.

REFERENCE BOOKS

1. **A Course in Electrical Power**- Soni, Gupta & Bhatnagar- 3rd Edition, Dhanapat Rai publication
2. **Power System Protection & Switchgear**- Ravindarnath & Chandra-New age publications.
3. **Electrical Power-** Dr S. L. Uppal- Khanna Publishers.
4. **Power System Protection-**Patra. S.P. Basu. S.K. Choudhari.S. Oxford, and IBH Publications.

Choice : Unit III & V

VIII SEMESTER

Subject	Intellectual Property Rights	Sub. Code	11HS8GCIPR
Credits	02	L-T-P	2-0-0

Unit 1 **[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 2 **[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.

Procedure 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 3 **[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 4 **[06 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 5 **[05 hours]**

Trade Marks: Introduction, Statutory authorities, procedure of registration of trade marks, rights conferred by registration of trade marks, licensing in trade mark, infringement of trade mark and action against infringement.

Text Books:

1. **Basic principles and acquisition of Intellectual Property Rights**, Dr. T Ramakrishna, CIPRA, NSLIU -2005.
2. **Intellectual Property Law Handbook**, Dr. B.L.Wadehhra, Universal Law Publishing Co. Ltd., 2002.

References:

1. **Ownership and Enforcement of Intellectual Property Rights**, Dr. T Ramakrishna , 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. **Patent Fundamentals for Scientist and Engineers**, Thomas T Gordon and Arthur S Cookfair, CRC Press 1995.
6. **Intellectual Property Rights**, Prabuddha Ganguli, TMH Publishing Co. Ltd, 2001.

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Subject	PROJECT MANAGEMENT	Sub. Code	11HS8GCPRM
Credits	02	L-T-P	2-0-0

UNIT 1 **[06 Hours]**

Introduction – Definitions – classifications – project risk – scope

UNIT 2 **[05 Hours]**

Project planning – scope – problem statement – project goals – objectives

UNIT 3 **[05 Hours]**

Project implementation – project resource requirements – types of resources – men – materials – finance

UNIT 4 **[05 Hours]**

Project monitoring – evaluation – control – project network technique –planning for monitoring and evaluation – project scheduling.

UNIT 5 **[05 Hours]**

Project team management – recruitment – organizing – human resources – team operating rules – project organization – various forms of project organizations.

TEXT BOOKS:

1. **Project Management,** for 21st Century, Beenet P Lientz, Kathyn Prea, Academic Press, 1995
2. **Project Management,** Denislok

REFERENCE BOOKS:

1. **Project Management,** David I Cleland, Mcgraw Hill International Edition, 1999
2. **Project Management,** Gopalakrishnan, Mcmillan India Ltd.
3. **Project Management**, Harry Maylor, Pearson Publication

GROUP 1 ELECTIVES

Subject	Object oriented Programming using C++	Sub. Code	10ES5GE1OP
Credits	04	L-T-P	4-0-0

UNIT 1 **[10 hours]**

PRINCIPLES OF OBJECT ORIENTED PROGRAMMING: OOP Concepts, 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 2 **[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 3 **[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 4 **[11 hours]**

INHERITANCE: Single and multiple inheritance, public, private and protected inheritance. Pointers, virtual functions and polymorphism. Pointers, 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 5 **[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
2. **Programming With C++,** Schaum'sseries, TMH Publications

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Subject	Digital System Design using VHDL	Sub. Code	10ES5GE1DD
Credits	04	L-T-P	4-0-0

UNIT 1 **[10 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 2 **[12 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 3 **[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 4 **[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 5 **[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:

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

REFERENCE BOOKS:

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

Subject	Data Structures With C++	Sub. Code	10ML5GE1DS
Credits	04	L-T-P	3-0-1

UNIT 1 **[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 2 **[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. Operator overloading: over loading of unary operators, binary operators, data conversion.

UNIT 3 **[07 hours]**

Inheritance: Inheritance, derived class and base class, overriding member functions, scope resolution, levels of inheritance, multiple inheritances.

UNIT 4 **[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 5 **[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	Biomechanics	Sub. Code	10ML5GE1BM
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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,Springer Verlag, 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	Communication Systems (EE Only)	Sub. Code	10EE5GE1CS
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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.

GROUP 2 ELECTIVES

Subject	Fundamentals of VLSI (EE only)	Sub. Code	10EE6GE2FV
Credits	04	L-T-P	4-0-0

UNIT 1 **[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.

UNIT 2 **[10 hours]**

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

UNIT 3 **[08 hours]**

MOS and BICMOS Circuit Design Processes: Mass layers, stick diagrams, design, symbolic diagrams.

UNIT 4 **[16 hours]**

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

b) Scaling Of MOS Circuits: Scaling model and scaling factors- Limit due to current density.

UNIT 5 **[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:

1. **Basic VLSI Design**, Pucknell Douglas Al , PHI, 3rd Edition

REFERENCE BOOKS:

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

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Subject	Utilization of Electrical Power	Sub. Code	10EE6GE2UP
Credits	04	L-T-P	4-0-0

UNIT 1 **[12 hours]**

Heating and welding: Advantages and methods of electric 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 2 **[08 hours]**

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

UNIT 3 **[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 4 **[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 5 **[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 **Utilization of Electric Power and Electric Traction -** J.B.Gupta, S.K Kataria and Sons

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

REFERENCE BOOK:

1. **Utilization of electric energy -** Openshaw Taylor, Orient Longman

Subject	Operating Systems Concepts	Sub. Code	10TC6GE2OS
Credits	04	L-T-P	4-0-0

UNIT 1 **[10 hours]**

Introduction and overview of operating systems: Operating system, Goals of an O.S, Operation of an O.S, Resource allocation and related functions, User interface related functions, Classes of operating systems, O.S and the computer system, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems.

UNIT 2 **[10 hours]**

Structure of operating systems: Operation of an O.S, Structure of the supervisor, Configuring and installing of the supervisor, Operating system with monolithic structure, layered design, Virtual machine operating systems, Kernel based operating systems, and Microkernel based operating systems.

UNIT 3 **[12 hours]**

Memory management: Memory allocation to programs, Memory allocation preliminaries, Contiguous and noncontiguous allocation to programs, Memory allocation for program-controlled data, kernel memory.

Virtual memory: Virtual memory basics, Virtual memory using paging, Demand paging, Page replacement, Page replacement policies, Memory allocation to programs, Page sharing, UNIX virtual memory.

UNIT 4 **[10 hours]**

File systems: File system and IOCS, Files and directories, Overview of I/O organization, Fundamental file organizations, Interface between file system and IOCS, Allocation of disk space, Implementing file access, UNIX file system.

UNIT 5 **[10 hours]**

Scheduling: Fundamentals of scheduling, Long-term scheduling, Medium and short term scheduling, Real time scheduling, Process scheduling in UNIX.

Message Passing: Implementing message passing, Mailboxes, Inter process communication in UNIX.

TEXT BOOK:

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

REFERENCE BOOKS:

1 **Operating Systems Concepts**, Silberschatz and Galvin, John Wiley, 5th Edition, 2001.

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

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Subject	Introduction to Image Processing	Sub. Code	10TC6GE2IP
Credits	04	L-T-P	3-0-1

UNIT 1 **[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 2 **[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 3 **[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 4 **[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.

UNIT 5 **[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.

TEXT BOOK:

1. **Digital Image Processing** by Rafael C. Gonzalez & Richard E. Woods, Second Edition. Pearson ducation.

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

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Subject	Biosensors	Sub. Code	10ML6GE2SN
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[10 hours]**

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

UNIT 3 **[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 4 **[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 5 **[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. H 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	Biostatistics	Sub. Code	10ML6GE2BS
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[08 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 4 **[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 5 **[14 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:

1. **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	Advanced Microcontrollers & Applications	Sub. Code	10EC6GE2MC
Credits	04	L-T-P	3-0-1

UNIT 1 **[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 2 **[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 3 **[08 hours]**

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

UNIT 4 **[08 hours]**

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

UNIT 5 **[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	DSP Architecture and Systems	Sub. Code	10EC6GE2DA
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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:

1. **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	Biomedical DSP	Sub. Code	10IT6GE2MD
Credits	04	L-T-P	3-0-1

UNIT 1 **[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 2 **[09 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 3 **[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 4 **[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 5 **[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:

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

GROUP-3 ELECTIVES

Subject	Embedded System Design (EE & ML only)	Sub. Code	10EE6GE3ED
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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.

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 **Real time systems**, Jane W.S., Liu, Pearson Education Asia Pub, 2004.
3 **Motorola and Intel Manuals**

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Subject	Electronic Instrumentation	Sub. Code	10EE6GE3EI
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[11 hours]**

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

UNIT 4 **[10 hours]**

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

UNIT 5 **[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:

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

Subject	Renewable Energy Resources	Sub. Code	10EE6GE3RE
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[11 hours]**

Energy storage: Energy storage systems, pumped hydro, compressed air storage, energy storage 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:

1. **Non-Conventional Sources of Energy**, G.D.Rai, Khanna Publishers, New Delhi, 4th Edition, 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	Real Time Embedded Systems (Except EC)	Sub. Code	10TC6GE3RT
Credits	04	L-T-P	4-0-0

UNIT 1 **[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 2 **[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 3 **[10 hours]**

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

UNIT 4 **[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 5 **[10 hours]**

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

TEXT BOOK:

1. **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	Introduction to speech and audio processing	Sub. Code	10TC6GE3SA
Credits	04	L-T-P	3-0-1

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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.

Course Name	**Design Of Analog & Mixed Mode VLSI Circuits (Except EC)**	**Course Code**	**10TC6GE3MM**
Credits	**04**	**L – T - P**	**4-0-0**

UNIT 1 **[10 hours]**

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

UNIT 2 **[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 3 **[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 4 **[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 5 **[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:

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

Course Name	Biomedical Circuits with VLSI	Course Code	10ML6GE3BC
Credits	04	L – T - P	4-0-0

UNIT 1 **[08 hours]**

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

UNIT 2 **[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 3 **[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 4 **[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 5 **[12 hours]**

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

TEXT BOOKS:

1. **Introduction to VLSI circuits and systems -** JOHN P. UYEMURA, John Wiley , Wiley 2001 edition. For Unit:1, 2,3.
2. **VLSI circuits for Biomedical Applications -** Krzysztof Iniewski Artech House 2008 edition. For Unit 4 and 5.

REFERENCE BOOK:

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

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Course Name	Rehabilitation Engineering	Course Code	10ML6GE3RE
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 Psychiatry 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 2 **[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, Mobilisation exercises, Endurance exercises.

UNIT 3 **[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 4 **[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 5 **[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:

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

Course Name	Adaptive signal processing	Course Code	10EC6GE3SP
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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.

Course Name	Image Processing Concepts	Course Code	10EC6GE3IP
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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:

1. **Digital Image Processing**, Rafael C. Gonzalez and Richard E. Woods, Pearson Education, 2009, 3rd edition.
2. **Fundamentals of Digital Image Processing**, Anil K. Jain, Pearson Edun, 2001.

REFERENCE BOOKS:

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

Course Name	Robotics	Course Code	10IT6GE3RB
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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 CIE

Project 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 detail6. 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

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Course Name	Digital Image Processing	Course Code	10IT6GE3DP
Credits	04	L – T - P	3-0-1

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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

Simulation and display of an image, negative of an image (Binary & Gray Scale), Implementation of relationships between pixels, Implementation of transformations of an image

Contrast stretching of a low contrast image, histogram, and histogram equalization, Display of bit planes of an image, Display of FFT (1-D & 2-D) of an image, Computation of mean, standard deviation and correlation co-efficient of the given images, Implementation of image smoothening filters (Mean and Median filtering of an image), Implementation of image sharpening filters and edge detection using gradient filters, Image compression by DCT, DPCM, HUFFMAN coding

Implementation of image restoring techniques, Implementation of image intensity slicing technique for image enhancement, Canny edge detection algorithm.

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:

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

Group 4 Electives

Course Name	High Voltage Engineering	Course Code	11EE7GE4HV
Credits	04	L – T - P	(3-0-1)

UNIT 1 **[08 hours]**

Breakdown Phenomena: Classification of HV insulating media, Properties of important HV insulating media under each category, Gaseous dielectrics: Ionizations: primary and secondary ionization processes, Criteria for gaseous insulation breakdown based on Townsend's theory, Limitations of Townsend's theory, Streamer's theory of breakdown in non-uniform fields, Corona discharges, Breakdown in electro negative gasses, Paschen's law and its significance, Time lags of Breakdown.

UNIT 2 **[08 hours]**

Generation of HVAC and DC Voltage: HV AC-HV transformer, Need for cascade connection and working of transformers units connected in cascade, Series resonant circuit- principle of operation and advantages, Tesla coil.HV DC voltage doubler circuit, cock croft- Walton type high voltage DC set, Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop.

UNIT 3 **[07 hours]**

Generation of Impulse Voltage and Current: Introduction to standard lightning and switching impulse voltages, Analysis of single stage impulse generator-expression for output impulse voltage, Multistage impulse generator, working of Marx impulse, Rating of impulse generator, Components of multistage impulse generator, Triggering of impulse generator by three electrode gap arrangement, Triggering gap and oscillograph time sweep circuits, Generation of switching impulse voltage, Generation of high impulse current.

UNIT 4 **[08 hours]**

Measurement of High Voltages: Electrostatic voltmeter-principle, construction and limitation. Chubb and Fortescue method for HV AC measurement, Generating voltmeter-principle, Construction, Standard sphere gap measurements of HV AC, HV DC, and impulse voltages; Factors affecting the measurements.

UNIT 5 **[08 hours]**

Non-destructive Insulation Testing Techniques: Dielectric loss and loss angle measurements using Schering Bridge. Need for discharge detection and PD measurements aspects. Factor affecting the discharge detection, Discharge detection methods- straight and balanced methods,High voltage tests on Electrical Apparatus**:** Definitions of terminologies, tests on isolators, circuit breakers, cables insulators and transformers.

Lab Experiments:

1. Estimation of breakdown of transformer oil.(Evaluation of K & n from the equation $v=kd^n$)
2. Measurement of HVAC using Spheregap (temperature pressure and humidity correction)
3. Measurement of HVAC using (a) point plane (b) plane-plane breakdown (Temperature, pressure and humidity correction)
4. Measurement of HVDC using sphere-sphere(Temperature, pressure and humidity correction)
5. Measurement of HVDC using (a) point plane (b) plane-plane breakdown (Temperature, pressure and humidity correction)
6. Electrolytic tank: Calculation for E(Electric field intensity) and capacitance C for the following configurations. (a) plane-plane (b) concentric cable model, drawing and analysis of equi-potential lines.
7. Tests on the following insulating materials in plate and sheet/thin film form. (a)Delrin (b)HDPE (c)Acrylic (d)PVC (e)Teflon (f)Polycarbonate (g)Bakelite (h)Polypropylene (i)Cast nylon (j)Polythelene & thinfilms/sheets & plates etc.

TEXT BOOKS:

1. **High Voltage Engineering Fundamentals-** E.Kuffel and W.S. Zaengi-2nd edition, Elsevier press, 2005
2. **High Voltage Engineering-** M.S.Naidu and Kamaraju- 3rd Edition, THM, 2007.
3. **High Voltage Engineering-** C.L.Wadhwa, New Age International Private limited, 1995.

REFERENCE BOOKS:

1. **Extra High Voltage AC Transmission Engineering-** Rakosh Das Begamudre, Wiley Eastern limited, 1987.
2. **Transmission and Distribution Reference Book-**Westing House.
3. **High Voltage Technology-**L.L.Alston- BSB Publication, 2007

Course Name	Power System Operation and Control	Course Code	11EE7GE4PO
Credits	04	L – T - P	(4-0-0)

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[10 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

Course Name	Industrial Drives & Applications	Course Code	11EE7GE4ID
Credits	04	L – T - P	(4-0-0)

UNIT 1 **[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 2 **[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 3 **[12 hours]**

DC 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 4 **[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 5 **[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:

1. **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.

Course Name	Low power Microcontroller	Course Code	11TC7GE4MC
Credits	04	L – T - P	(3-0-1)

UNIT 1 **[08 hours]**

Introduction - Motivation for MSP430microcontrollers – Low Power embedded systems Main characteristics of a MSP430 microcontroller, 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), Main features of the MSP430X CPU architecture, MSP430X CPU registers.

UNIT 2 **[08 hours]**

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

UNIT 3 **[08 hours]**

On-Chip Peripherals: Hardware Multiplier, analog-to-digital Converters, An ADC Example, LCD Driver System reset, System clocks, Interrupt management, Types of interrupts, Watchdog timer (WDT and WDT+), Supervisory Voltage System (SVS).

UNIT 4 **[08 hours]**

General Purpose I/O- Registers, Flashing LED, Blinking the LED, Blinking the LED half the speed, toggle the LED state by pressing the push button, Enable / disable LED blinking by push button, Timers Introduction: Basic Timer 1, Capture/Compare blocks, Timer_A Interrupts, Timer_B special features

UNIT 5 **[07 hours]**

Low-power Design & Case Studies of applications of MSP430**:** MSP430 power consumption characteristics, MSP430 low-power modes, Periodic Interrupts and Low-Power Design, Interrupts and Low-Power Design, LCD Controller Introduction, LCD_A Controller Operation, Data Acquisition Introduction

Lab Experiments

Basic debug introduction using CCE
MSP430-EXP430FG4618 Flashing LED
ez430-F2013 Flashing LED
Memory clock with Basic Timer 1
LCD message Display
Sample Temperature using SAR ADC10
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.

This syllabus is framed with guidance from Texas Instruments

REFERENCE BOOKS:

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

Course Name	Introduction to Multimedia Concepts	Course Code	11TC7GE4MM
Credits	04	L – T - P	3-0-1

(Prerequisite: Audio/Image processing using Matlab)

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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:

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

REFERENCE BOOK:

1. **Data Compression: The Complete Reference** – David Salomon, Springer, Fourth Edition, 2007.

Course Name	Software Defined Radio	Course Code	11TC7GE4SR
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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:

1. **Software Defined Radio -** Dr Walter Tuttlebee, Wiley

REFERENCE BOOKS:

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

Course Name	Satellite Communication	Course Code	11TC7GE4SC
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[10 hours]**

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

UNIT 4 **[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 5 **[10 hours]**

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

TEXT BOOK:

1. **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.

Course Name	Hospital Management Systems	Course Code	11ML7GE4HM
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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

Course Name	Physiological Control Systems	Course Code	11ML7GE4PC
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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:

1. **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

Course Name	Wireless Communication	Course Code	11EC7GE4WC
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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)

Course Name	Embedded System Design	Course Code	11EC7GE4ES
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 representationfor each category.

UNIT 2 **[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 3 **[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 4 **[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 5 **[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. **Embedded System – Architecture, Programming, Design,** Rajkamal, Tata McGraw Hill, 2003.
2. **Fundamentals of Embedded Software**, Daniel W. Lewis, Prentice Hall of India, 2004.

REFERENCE BOOK:

1. **An Embedded Software Primer**, David E. Simon, Pearson Education, 2004.
2. **Embedded System Design – A Unified hardware & Software Introduction**, Frank Vahid, John Wiley, 2002.
3. **Embedded Real Time Systems Programming**, Sriram V. Iyer, Pankaj Gupte, Tata McGrawHill, 2004.
4. **Embedded System Design**, Steve Heath, II edition, Elsevier, 2003

Course Name	Distributed Computing	Course Code	11IT7GE 4DC
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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.

Course Name	Medical Imaging Systems (Except ML)	Course Code	11IT7GE4MI
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[09 hours]**

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

UNIT 3 **[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 4 **[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 5 **[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.

GROUP 5 ELECTIVES

Course Name	Low Power VLSI design	Course Code	11EC7GE5LP
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[10 hours]**

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

UNIT 4 **[10 hours]**

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

UNIT 5 **[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 BOOKS:

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.

BMS COLLEGE OF ENGINEERING, BANGALORE

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Course Name	Network Security	Course Code	11EC7GE5NS
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[10 hours]**

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

UNIT 5 **[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

Course Name	Multimedia Communication	Course Code	11EC7GE5MM
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[08 hours]**

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

UNIT 3 **[12 hours]**

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

UNIT 4 **[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 5 **[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. **Multimedia Communications -** Fred Halsall, Pearson education, 2001 (unit 1-4)
2. **Multimedia Communication Systems** K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Pearson education, 2004 (unit 5)

REFERENCE BOOK:

1. **Multimedia Information Systems -** Pallapa Venkataram, Pearson education (In Press), 2005

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Course Name	EMC –EMI	Course Code	11TC7GE5EM
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[10 hours]**

EMC Standard and Regulations:

National and international standardizing organizations,-FCC, CE, and RE standards, frequency assignment-spectrum conversation

UNIT 4 **[10 hours]**

EMI Control Methods and Fixes: Shielding, grounding, bonding, filtering, EMI gasket, isolation transformer, optical isolator

UNIT 5 **[10 hours]**

EMC Design and Interconnetion Techniques:

Cable routing and connection, component selection and mounting, PCB design-Trace routing, impedance control, decoupling, zoning and grounding

TEXT BOOKS:

1. **Engineering Electromagnetic Compatibility** - Prasad Kodali.V - S.Chand&Co - New Delhi - 2000
2. **Introduction to Electromagnetic compatibility** - Clayton R.Paul - Wiley & Sons - 1992

REFERENCE BOOKS:

1. **Principles of Electromagnetic Compatibility** - Keiser -Artech House - 3rd Edition - 1994
2. **Handbook of EMI / EMC** - Donwhite Consultant Incorporate - Vol I - 1985

Course Name	Computer Communication and Networking	Course Code	11ES7GE5CN
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[10 hours]**

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

UNIT 5 **[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

Course Name	ASIC Design	Course Code	11TC7GE5AD
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[11 hours]**

Programmable Asics

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

UNIT 4 **[11 hours]**

Programmable ASIC I/O cells, Programmable ASIC interconnect.

UNIT 5 **[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:

1. **Application - Specific Integrated Circuits -** M.J.S .Smith, - Pearson Education, 2003

REFERENCE BOOKS:

1. **Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing -** Jose E.France, Yannis Tsividis, Prentice Hall, 1994.
2. **Analog VLSI Design - NMOS and CMOS -** Malcolm R.Haskard; Lan. C. May, Prentice Hall, 1998.
3. **Analog VLSI Signal and Information Processing -** Mohammed Ismail and Terri Fiez, McGraw Hill, 1994.

Course Name	Electrical Machine Design & Drawing	Course Code	11EE7GE5MD
Credits	04	L – T - P	3-0-1

UNIT 1 **[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 2 **[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 3 **[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**.**

Introduction, types of motors, output equation, choice of specific loadings.

UNIT 4 **[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 5 **[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 course in electrical machine design** - A.K.Sawhney, Dhanpat Rai & Sons
2. **Design of electrical Machines** - V.N.Mittle, 4/e edition, Standard Publishers.

REFERENCE BOOKS:

1. **Performance & Design of AC Machines** - M.G.Say, CBS Publisher & Distributors
2. **Principles of Electrical Machine Design** - R.K.Aggarwal

Course Name	Switch Mode Power Supplies	Course Code	11EE7GE5SP
Credits	04	L – T - P	4-0-0

UNIT 1 **[10 hours]**

Introduction To DC-DC Switched Mode Converters: Basic Topologies, Buck, boost, buck-boost, and Cuk converters.

UNIT 2 **[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 3 **[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 4 **[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 5 **[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

Course Name	Embedded System & RTOS	Course Code	11IT7GE5ES
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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.

Course Name	Advanced Biomedical Digital Signal Processing	Course Code	11ML7GE5SP
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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.

Course Name	Advanced Medical Image Processing	Course Code	11ML7GE5IP
Credits	04	L – T - P	4-0-0

UNIT 1 **[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 2 **[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 3 **[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 4 **[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 5 **[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:

1. **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.

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Cluster: Electrical Science Cluster

Programs: EC / EE / TC / IT / ML **Semester: III**

Subject Code	Subject Title	Credits				Contact hrs/wk	Marks		
		L	T	P	Total		CIE	SEE	Total
09MA3ICMAT	Engineering Mathematics-III	3	1	0	4	5	50	50	100
09ES3GCNAL	Network Analysis	4	0	0	4	4	50	50	100
09ES3GCAEC	Analog Electronic Circuits	4	0	1	5	6	50	50	100
09ES3GCDEC	Digital Electronics	4	0	1	5	6	50	50	100
09ES3GCFTH	Field Theory	4	0	0	4	4	50	50	100
09ES3GCMST	Measurement Techniques	3	0	0	3	3	50	50	100
				Total	25	28			600

L – Lecture Hours / week; **T** - Tutorial Lecture Hours / week; **P** - Practical Lecture Hours / week.
CIE - Continuous Internal Evaluation; **SEE** - Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Cluster: Electrical Science Cluster

Programs: EC / EE / TC / IT / ML **Semester: IV**

Subject Code	Subject Title	Credits				Contact hrs/wk	Marks		
		L	T	P	Total		CIE	SEE	Total
09MA4ICMAT	Engineering Mathematics-IV	3	1	0	4	5	50	50	100
09ES4GCLIC	Op-amps and Linear ICs	4	0	1	5	6	50	50	100
09ES4GCMPR	8086 Microprocessor	3	0	1	4	5	50	50	100
09ES4GCSAS	Signals and Systems	4	0	0	4	4	50	50	100
09ES4GCCST	Control Systems	4	0	0	4	4	50	50	100
09ES4GCHDL	Fundamentals of HDL	3	0	1	4	5	50	50	100
				Total	25	29			600

L – Lecture Hours / week; **T** - Tutorial Lecture Hours / week; **P** - Practical Lecture Hours / week.
CIE - Continuous Internal Evaluation; **SEE** - Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

(Autonomous College under VTU)

Department: ELECTRICAL & ELECTRONICS

Program Code: EE **Semester: V**

Subject Code	Subject Title	Credits				Contact hrs/wk	Marks		
		L	T	P	Total		CIE	SEE	Total
10EE5DCTND	Transmission & Distribution	4	0	0	4	4	50	50	100
10EE5DCFDP	Fundamentals of Digital Signal Processing	3	1	0	4	5	50	50	100
10EE5DCTIM	Transformers & Induction Machines	4	0	1	5	6	50	50	100
10EE5DCEPG	Electrical Power Generation	3	0	0	3	3	50	50	100
10ES5GCMCS	Microcontrollers	3	0	1	4	5	50	50	100
10EE5DCMCL	Measurements and Controls Lab	0	0	1	1	2	25	25	50
10XX5GE1XX	Elective-I	4	0	0	4	4	50	50	100
				Total	25	29			650

DC- Department Core , **L** – Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

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Department: ELECTRICAL & ELECTRONICS

Program Code: EE **Semester: VI**

Subject Code	Subject Title	Credits				Contact hrs/wk	Marks		
		L	T	P	Total		CIE	SEE	Total
10EE6DCPSA	Power System Analysis	3	1	0	4	5	50	50	100
10EE6DCDSM	DC and Synchronous Machines	4	0	1	5	6	50	50	100
10EE6DCPEN	Power Electronics	4	0	1	5	6	50	50	100
10EE6DCMCT	Modern Control Theory	3	0	0	3	3	50	50	100
10XX6GE2XX	Elective-II	4	0	0	4	4	50	50	100
10XX6GE3XX	Elective-III	4	0	0	4	4	50	50	100
				Total	25	28			600

DC- Department Core , **L** – Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

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Department: ELECTRICAL & ELECTRONICS

Program Code: EE **Semester: VII**

Subject Code	Subject Title	Credits				Contact hrs/wk	Marks		
		L	T	P	Total		CIE	SEE	Total
11HS7GCHRM	Human Resource Management	2	0	0	2	2	50	50	100
11EE7DCCTP	Computer Techniques in Power Systems	4	0	1	5	6	50	50	100
11EE7DCSGP	Switchgear and Protection	4	0	1	5	6	50	50	100
11XX7GE4XX	Elective IV	4	0	0	4	4	50	50	100
11XX7GE5XX	Elective V	4	0	0	4	4	50	50	100
11XX7IE1XX	Institutional Elective - I	4	0	0	4	4	50	50	100
11EE7DCSMR	Seminar	0	0	1	1	2	50	-	50
				Total	25	28			650

DC- Department Core , **L** – Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

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Department: ELECTRICAL & ELECTRONICS

Program Code: EE **Semester: VIII**

Subject Code	Subject Title	Credits				Contact hrs/wk	Marks		
		L	T	P	Total		CIE	SEE	Total
11HS8GCIPR	Intellectual Property Rights	2	0	0	2	2	50	50	100
11HS8GCPRM	Project Management	2	0	0	2	2	50	50	100
11XX8IE2XX	Institutional Elective -II	4	0	0	4	4	50	50	100
11IT8DCSMR	Seminar	0	0	1	1	1	50	-	50
11IT8DCPRJ	Project Work	0	0	16	16	24	200	100	300
				Total	25	33			650

DC- Department Core , **L** – Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

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Group I Electrical Cluster Electives **Semester: V**

Subject Code	Subject Title	Credit Hours/Week				Contact hrs/wk	Marks		
		L	T	P	Total Credits		CIE	SEE	Total
10ES5GE1OP	Objected oriented programming using C++	4	0	0	4	4	50	50	100
10ES5GE1DD	Digital System Design using VHDL	4	0	0	4	4	50	50	100
10ML5GE1DS	Data Structures With C++	3	0	1	4	5	50	50	100
10ML5GE1BM	Biomechanics	4	0	0	4	4	50	50	100
10EE5GE1CS	Communication Systems (EE only)	4	0	0	4	4	50	50	100

GE- Group Elective **L** - Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

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Group II Electrical Cluster Electives **Semester: VI**

Subject Code	Subject Title	Credit Hours/Week				Contact hrs/wk	Marks		
		L	T	P	Total Credits		CIE	SEE	Total
10EE6GE2FV	Fundamentals of VLSI (EE only)	4	0	0	4	4	50	50	100
10EE6GE2UP	Utilization of Electrical Power	4	0	0	4	4	50	50	100
10TC6GE2OS	Operating Systems Concepts	4	0	0	4	4	50	50	100
10TC6GE2IP	Introduction to Image processing (Except ML)	3	0	1	4	5	50	50	100
10ML6GE2SN	Bio Sensors	4	0	0	4	4	50	50	100
10ML6GE2BS	Bio Statistics	4	0	0	4	4	50	50	100
10EC6GE2MC	Advanced Microcontroller and Applications	3	0	1	4	5	50	50	100
10EC6GE2DA	DSP Architecture and Systems (Except TC, IT)	4	0	0	4	4	50	50	100
10IT6GE2MD	Biomedical DSP (Except ML)	3	0	1	4	5	50	50	100

GE- Group Elective **L** - Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE
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Group III Electrical Cluster Electives **Semester: VI**

Subject Code	Subject Title	Credit Hours/Week				Contact hrs/wk	Marks		
		L	T	P	Total Credits		CIE	SEE	Total
10EE6GE3ED	Embedded System Design (only EE and ML)	4	0	0	4	4	50	50	100
10EE6GE3EI	Electronic Instrumentation	4	0	0	4	4	50	50	100
10EE6GE3RE	Renewable Energy Resources	4	0	0	4	4	50	50	100
10TC6GE3RT	Real Time Embedded System (Except EC)	4	0	0	4	4	50	50	100
10TC6GE3SA	Introduction to Speech and Audio Processing	3	0	1	4	5	50	50	100
10TC6GE3MM	Design of Analog and Mixed mode VLSI circuits (Except EC)	4	0	0	4	4	50	50	100
10ML6GE3BC	Biomedical circuits with VLSI	4	0	0	4	4	50	50	100
10ML6GE3RE	Rehabilitation Engineering	4	0	0	4	4	50	50	100
10EC6GE3SP	Adaptive signal Processing	4	0	0	4	4	50	50	100
10EC6GE3IP	Image Processing Concepts (Except ML)	4	0	0	4	4	50	50	100
10IT6GE3RB	Robotics	4	0	0	4	4	50	50	100
10IT6GE3DP	Digital Image Processing (Except ML)	3	0	1	4	5	50	50	100

GE- Group Elective **L** - Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

BMS COLLEGE OF ENGINEERING, BANGALORE

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Group IV Electrical Cluster Electives **Semester: VII**

Subject Code	Subject Title	Credit Hours/Week				Contact hrs/wk	Marks		
		L	T	P	Total Credits		CIE	SEE	Total
11EE7GE4HV	HV Engineering	3	0	1	4	5	50	50	100
11EE7GE4PS	Power Systems Operation and Control	4	0	0	4	4	50	50	100
11EE7GE4ID	Industrial Drives and Applications	4	0	0	4	4	50	50	100
11TC7GE4MC	Low power Microcontroller	3	0	1	4	5	50	50	100
11TC7GE4MM	Introduction to Multimedia Communication	3	0	1	4	5	50	50	100
11TC7GE4SR	Software Defined Radio	3	0	1	4	5	50	50	100
11TC7GE4SC	Satellite Communication	4	0	0	4	4	50	50	100
11ML7GE4HM	Hospital Management Systems	4	0	0	4	4	50	50	100
11ML7GE4PC	Physiological Control Systems	4	0	0	4	4	50	50	100
11EC7GE4WC	Wireless communication (Except TC)	4	0	0	4	4	50	50	100
11EC7GE4ES	Embedded Systems Design	4	0	0	4	4	50	50	100
11IT7GE4DC	Distributed Computing	4	0	0	4	4	50	50	100
11IT7GE4MI	Medical Imaging Systems (Except ML)	4	0	0	4	4	50	50	100

GE- Group Elective **L** - Lecture Hours / week; **T**- Tutorial Lecture Hours / week; **P**-Practical Lecture Hours / week.
CIE- Continuous Internal Evaluation; **SEE**- Semester End Examination (of 3 Hours duration)

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

Group V Electrical Cluster Electives **Semester: VII**

Subject Code	Subject Title	Credit Hours/Week				Contact hrs/wk	Marks		
		L	T	P	Total Credits		CIE	SEE	Total
11EC7GE5LP	Low Power VLSI design	4	0	0	4	4	50	50	100
11EC7GE5NS	Network Security	4	0	0	4	5	50	50	100
11EC7GE5MM	Multimedia Communication	4	0	0	4	4	50	50	100
11TC7GE5EM	EMC -EMI	4	0	0	4	4	50	50	100
11ES7GE5CN	Computer Communication Networks (Except EC)	4	0	0	4	4	50	50	100
11TC7GE5AD	ASIC Design (Except EC)	4	0	0	4	4	50	50	100
11EE7GE5MD	Electrical Machine Design and Drawing	3	0	1	4	5	50	50	100
11EE7GE5SP	Switch Mode Power Supplies	4	0	0	4	4	50	50	100
11IT7GE5ES	Embedded System and RTOS	4	0	0	4	4	50	50	100
11ML7GE5SP	Advanced Biomedical Digital Signal Processing	4	0	0	4	4	50	50	100
11ML7GE5IP	Advanced Medical Image Processing	4	0	0	4	4	50	50	100

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