BANGALORE UNIVERSITY
Department of Electronic Science

Regulations and scheme of study for the Electronic Science programme

Preamble:

The Post Graduate [PG] programmes in Bangalore University are restructured to implement the Choice Based Credit System [CBCS] semester scheme from the academic year 2014 – 15. The University will provide an exit option at the end of the 1st year of the PG program with an Honours degree. On the successful completion of the second year of the PG programme the candidate will be awarded an M. Sc. degree.
The introduction of the CBCS system will provide flexibility and mobility to the students, both within and outside the university.

Eligibility:

A science graduate with 3 years of study and with a minimum of 50% marks in the aggregate of all the optional subjects with the following combinations: Physics, Mathematics & Electronics or Physics, Mathematics & Instrumentation or Computer Science, Mathematics & Electronics are eligible for admission to the 1st year M. Sc. programme. B. Sc. honours [4 years] students with Electronics specialisation are eligible for admission to the 2nd year M. Sc program of the university.
The admission procedures are as per the guidelines of the university.

Salient features of the CBCS M. Sc. course in Electronic Science:

The 2 year or 4 semester M Sc in Electronic Science will have credits in the range of 24 to 26 per semester and a total of 100 credits for the M Sc degree programme. The number of credits is based on the number of instructional hours/week - 1 credit is offered for 1hour instruction in theory, and 1 credit for 2 hours of practical or project/week.

The features of the CBCS system in Electronic Science are:

1. The courses offered are classified as core, soft core and electives.
2. The choice based courses may be offered within the faculty and/or across faculties.
3. The course curricula are unitised.
4. There is an end of term project in the 4th semester. Candidates are encouraged to carry out the project work in government research organizations/recognized R & D centres or industries so that they get a hands on exposure to the industrial environment. Students can also do their project work within the department. All permanent faculty members and guest faculty members with more than 3 years of teaching experience are the project guides/internal Guides. Scientists in other organizations, who are guiding the candidates shall be the external guides. The project report/ dissertation shall be submitted at the end of the semester.
5. Scheme of examination is as per the university guidelines.
6. The declaration of results is based on the Grade Point Average [GPA] earned at the end of each semester and the CGPA at the end of the program. An alpha-sign grade is also declared.

Details of Course Pattern and Scheme of Examination and Syllabus for I, II, III and IV Semester

ELECTRONIC SCIENCE

Subject code	SUBJECTS	PAPER	Inst. Hrs./ week	Duration of Exam (Hrs)	Marks			Credits
					IA	EXAM	TOTAL	
I Semester of PG program								
ELC 101	Physics of Semiconductor Devices	T	4	3	30	70	100	4
ELC 102	Network Analysis and Synthesis	T	4	3	30	70	100	4
ELC 103	Power Electronics	T	4	3	30	70	100	4
ELC 104	Programming in C++	T	4	3	30	70	100	4
ELC 105P	Power Electronics Lab	P	8	6	30	70	100	4
ELC 106P	C++ Programming Lab	P	8	6	30	70	100	4
ELS 107	Signals and Systems	T	3	3	30	70	100	2
							Total Credits	**26**

Subject code	SUBJECTS	PAPER	Inst. Hrs./ week	Duration of Exam (Hrs)	Marks			Credits
					IA	EXAM	TOTAL	
II Semester of PG program								
ELC 201	Advanced Microprocessors & Assembly Language Programming	T	4	3	30	70	100	4
ELC 202	Microwave Devices and Circuits	T	4	3	30	70	100	4
ELC 203	Digital Electronics and VHDL	T	4	3	30	70	100	4
ELC 204	Instrumentation and Microcontrollers	T	4	3	30	70	100	4
ELC 205P	Assembly Language Programming (8086) and Interfacing with PIC Microcontroller Lab	P	8	6	30	70	100	4
ELC 206P	VHDL Programming Lab	P	8	6	30	70	100	4
ELS 207	VLSI Technology	T	3	3	30	70	100	2
							Total Credits	26

Subject code	SUBJECTS	PAPER	Inst. Hrs./ week	Duration of Exam (Hrs)	Marks			Credits
					IA	EXAM	TOTAL	
III Semester of PG program								
ELC 301	Digital Signal Processing	T	4	3	30	70	100	4
ELC 302	Advanced Communication Systems	T	4	3	30	70	100	4
ELC 303	Modern Control Systems	T	4	3	30	70	100	4
ELC 304	**Open Elective:** Basics of Digital Electronics and Communication	T	4	3	30	70	100	4
ELC 305A-P	Digital Signal Processing Lab	P	4	3	15	35	50	2
ELC 305B-P	Control Systems Simulation Lab	P	4	3	15	35	50	2
ELC 306A-P	Communication Lab	P	4	3	15	35	50	2
ELC 306B-P	Microwave and Communication Simulation Lab	P	4	3	15	35	50	2
							Total Credits	**24**

Subject code	SUBJECTS	PAPER	Inst. Hrs./ week	Duration of Exam (Hrs)	Marks			Credits
					IA	EXAM	TOTAL	
IV Semester of PG program								
ELC 401	Embedded System Design	T	4	3	30	70	100	4
ELC 402	High Power Devices and Nano Electronics	T	4	3	30	70	100	4
ELC 403	Project			Viva+ Dissertation	50	50(Viva)+ 200 (dissertation)	300	12
Elective papers								
ELE 404A	Computer Networks	T	4	3	30	70	100	4
ELE 404B	Image Processing							
ELE 404C	Medical Instrumentation Systems							
ELE 404D	Antenna Theory and Design							
ELE 404E	Advanced Power Electronics							
ELE 404F	Multimedia Communication							
ELE404G	Speech Processing							
ELE 404H	System on Chip							
ELE 404I	Wavelet Transforms							
ELE 404J	Wireless Communication							
ELE 404K	ARM Processors and Real-Time Operating Systems							
							Total Credits	24

ELC 101: PHYSICS OF SEMICONDUCTOR DEVICES

Total No. Hours:52

Credits:4

Unit 1 **10 hours**

Crystal properties: semiconductor materials, crystal lattices, bonding forces in solids.
Growth of semiconductors: bulk crystal growth from melt, float zone process, epitaxial growth.

Unit 2 **15 hours**

Energy bands: energy band formation, Kronig – Penney model, metals, semiconductors and insulators.
Carrier concentration in thermal equilibrium: charge carriers in semiconductors – electrons and holes, effective mass, intrinsic and extrinsic materials, Fermi level, density of states, carrier concentration at equilibrium, law of mass action, temperature dependence of carrier concentration.
Carrier transport phenomena: Conductivity and mobility, carrier drift, effects of temperature and doping on mobility, high field effects, Hall effect. Diffusion of carriers, built in fields, continuity equation, Haynes – Shockley experiment.

Unit 3 **10 hours**

p-n junctions: Fabrication of p-n junctions, equilibrium conditions, contact potential, current flow at a junction, junction breakdown, capacitance of p-n junctions, charge storage and transient behavior.
Metal semiconductor junctions: Schottky barriers, rectifying and ohmic contact, heterojunctions.
p-n junction diodes: rectifiers, switching diodes, varactor diodes, tunnel diodes, photo diodes, solar cells, photo detectors, light emitting diodes.

Unit 4 **7 hours**

Bipolar transistors: BJT fabrication, transistor action, minority carrier distributions, terminal currents, Ebers – Moll model, switching.
Secondary effects: drift in base region, base narrowing, avalanche breakdown, injection level effects, emitter crowding.

Unit 5 **10 hours**

Field effect transistors: Junction FET, working, VI characteristic, metal semiconductor FET, GaAs MESFET, high electron mobility transistor.
Metal insulator semiconductor FETs: construction, operation, ideal MOS capacitor, threshold voltage, MOSFET.

References:

1. Solid state electronic devices: Ben G Streetman, PHI, 2003
2. Semiconductor Devices Physics and Technology: S M Sze, John Wiley, 2002
3. Foundation of Electronic Devices: M Sathyam & K Ramkumar
4. Semiconductor Devices: Kanaan Kano, Pearson Education, 2004.
5. Semiconductor Devices: Modelling and Technology, Nandita Das Gupta and Amitava Das Gupta, PHI, 2004.
6. Semiconductor Physics and Devices – Basic Principles, Donald A Neamen, TMH, 2003.

ELC 102: NETWORK ANALYSIS AND SYNTHESIS

Total No. Hours:52

Credits:4

Unit 1 **20 hours**

Introduction:

Kirchoff's laws: Node voltage analysis and mesh voltage analysis, network solutions using first order differential equation, initial conditions in networks.

Analysis of networks using Laplace transformation: Basic theorems of Laplace transformation, examples of solutions of networks using Laplace transformation. Transforms of signal waveform: the shifted unit step function, the ramp and impulse functions. Waveform synthesis, the initial and final value theorems, convolution integral, convolution as summation.

Unit 2 **13 hours**

Impedance functions and network theorems: Concept of complex frequency, transform impedance and transform circuits, series and parallel combinations of elements, superposition and reciprocity, Thevenin's, Norton's, maximum power transfer and Tellegen's theorem.

Two–port parameters: Relationship of two-port variable, the open circuit impedance parameters, short- circuit admittance parameters, transmission parameters, inverse transmission parameters, the hybrid parameters, inverse hybrid parameters, relationships between parameter sets, series, parallel and cascade connection of two-port networks.

Unit 3 **14 hours**

Network functions, poles and zeros: Terminal pairs or ports, network functions for one port and two port networks, the calculation of network functions, poles and zeros of network functions, restriction on pole and zero locations for driving–point functions and transfer functions, time domain behaviour from the pole and zero plot, stability of active networks, transient response, sinusoidal steady state analysis.

Frequency response plots: Network response due to sinusoidal input functions, plots from s-plane phasors, magnitude and phase plots.

Unit 4 **5 hours**

Network synthesis: Introduction, scaling network functions, positive real functions, Hurwitz polynomials, driving point synthesis with LC elements, elementary synthesis opertions, synthesis of dissipative networks- 2 terminal RC and RL networks (Foster and Cauer forms), properties of RL and RC network functions.

References:

1. Network Analysis: Van Valkenburg, PHI, 2003
2. Network Analysis and Synthesis: Bakshi A V, Bakshi U A, Technical Publications, 2009.
3. Electric circuits: Joseph Edminister, Schaum's series-Mc Graw Hill.
4. Network analysis and synthesis: Franklin F Kuo, John Wiley and sons, 2nd edition.
5. Networks and systems: Roy Choudhury D, New Age International, 2004.

ELC 103: POWER ELECTRONICS

Total No. Hours:52
Credits:4

Unit 1 **12 hours**

Introduction to power electronics: Power semiconductor devices: Power diodes, thyristors, power MOSFETs, power transistors, IGBT, MCT, LTT, smart power devices.
Thyristor firing circuits: Limitations of di/dt and dv/dt ratings, main features of firing circuits, R and RC firing circuits, UJT firing circuit. **Commutation Techniques:** Class A to Class F commutation methods, series and parallel operation of thyristors.
Diode circuits: Diode circuits with DC source- R, L,C, RL, RC, RLC load, recovery of trapped energy, RL load with freewheeling diode. **Diode rectifiers:** Half-wave rectifiers with R, L, C, RL, RC load, RL load with freewheeling diode, load with electromotive force.

Unit 2 **7 hours**

Phase controlled rectifiers: Single phase half wave rectifiers: with R load, RL load, RL load with freewheeling diode, RLE load. **Single phase full wave converters:** Single phase semi converters, single phase two pulse converters with continuous and discontinuous current.
Three-phase converter: System using diodes and thyristors, three-phase full converters, three-phase semi converters, dual converters.

Unit 3 **7 hours**

AC Voltage controllers: types of AC voltage controllers, integral cycle control, single phase voltage controllers, with R and RL loads, single-phase transformer tap changers, single-phase sinusoidal voltage controllers, working of three-phase controllers with star & delta loads.
Cycloconverters: Principle of cycloconverter operation, single-phase to single-phase circuit, step-up and step-down cycloconverter, three-phase half wave cycloconverter, output voltage equation of a cycloconverter, load commutated cycloconverter.

Unit 4 **16 hours**

Inverters: Principle of operation, single-phase voltage source inverters, basic series and parallel inverter circuits, types of inverters, three-phase bridge inverters, voltage control in single-phase inverters, pulse-width modulated inverters, current source inverters.
Choppers: Basic principle, control strategies, step-up and step-down choppers, types of chopper circuits, Switching-mode regulators- buck regulators, boost regulators, buck-boost regulators, cuk regulators.

Unit 5 **10 hours**

Introduction to motors: DC Motors: Working principle of DC motor, shunt motor, series motor, starter, closed loop control of DC drive, PLL control of DC drive.
AC Motors: Working principle of AC motor, type of AC motors, torque speed characteristics of induction motor, single phase induction motor drive, three phase induction motor drive, speed control of induction motor- stator voltage control and V/f control, synchronous motor, working principle of synchronous motor.

References:

1. Power Electronics: Bimbhra P S, Khanna Publishers, 2003.
2. Power Electronics Circuit devices and applications: Rashid M H, PHI.
3. Thyristor Engineering: Berde, M S Khanna publishers.
4. Power Electronics: Vedam Subrahmanyam, New Age International, 2002.
5. Modern Power Electronics and AC Drives: Bimal K Bose, Pearson Education, 2002.
6. Power Electronics: Mohan, Undeland, Robbins, John Wiley, 2003.

ELC 104: PROGRAMMING IN C++

Total No. Hours:52

Credits:4

Unit 1 **15 hours**

Introduction: Object oriented programming, characteristics of an object-oriented language.

C++ programming language: Tokens, keywords, identifier and constants, basic data types, user defined data types, derived data types, arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, special operators, expressions and evaluation of expressions, scope resolution operator, member dereferencing operators, manipulators, type cast operator, implicit conversions, precedence of operators, new and delete operators.

Arrays, pointers and structures.

Unit 2 **9 hours**

Decision making, branching and looping: if, if-else, else-if, switch statement, break, continue and go to statement, for loop, while loop and do loop.

Functions: Function definition, function arguments and passing, returning values from functions, referencing arguments, function overloading, virtual functions, library functions, local, static and global variables.

Unit 3 **12 hours**

Classes and objects: Classes and objects, member functions, class constructors and destructors, array of objects, operator overloading.

Class inheritance: Derived class and base class, multiple inheritance, polymorphism.

Unit 4 **8 hours**

Managing Console I/O Operation: C++ streams, C++ stream classes, unformatted I/O operations, formatted console I/O operations, managing output with manipulators.

Working with files: Classes for file stream operations, opening and closing a file, detecting end-of file, file modes, file pointers and their manipulations, updating a file, error handling during file operations, command-line arguments.

Templates: class templates, class templates with multiple parameters, function templates, function templates with multiple parameters, overloading of template function, member function templates, non-type template arguments.

Unit 5 **8 hours**

Exception handling: basics of exception handling, exception handling mechanism, throwing mechanism, catching mechanism, rethrowing an exception, specifying exception.

Introduction to the standard template library: components of STL, containers, algorithms, iterators, application of container classes, function objects.

Manipulating strings: creating string objects, manipulating string objects, relational operations, string characteristics, accessing characters in strings, comparing and swapping.

References:

1. Object- oriented programming with C++: Balagurusamy E, TMH, 2005
2. The Waite group's object oriented programming in Turbo C++: Robert Lafore, Galgotia Publication. Pvt. Ltd, 2005.

ELC 105P: Power Electronics Lab

Credits:4

PART A

Hardware Lab

1. Study of DIAC and TRIAC characteristics.
2. Study of R-Triggering and RC triggering of an SCR.
3. Study of RC full wave triggering circuit.
4. Half wave voltage controller converter (UJT) with R and DC motor load
5. Study of single phase semi converter with R load and DC motor load.
6. Study of AC motor speed controller using TRIAC.
7. Design of boost regulator using PWM IC 3524.
8. Speed control of DC motor using PWM IC 3524.
9. Construction and study of a controlled full wave converter.
10. Construction and study of an inverter using SCR.

[Any 8 experiments shall be performed]

PART B

Simulation Lab

1. Single phase converter using power diode – study of power factor.
2. Three phase converters using power diodes – study of power factor.
3. Single phase inverter using MOSFET's or IGBT's - determination of THD and power factor using FFT analysis.
4. Three phase inverter using MOSFET's or IGBT's - determination of THD and power factor using FFT analysis.
5. Study of buck and boost voltage regulators using power transistor.

[All simulations to be performed]

ELC 106P: C++ PROGRAMMING LAB

Credits:4

PART A

1. a] To generate the Fibonacci series up to the given limit N and also to print the number of elements in the series.
   b] Find the GCD of 2 integer numbers.
   c] Write a function to calculate factorial of a given number.

2. To find the minimum and maximum of N numbers.

3. To find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non – zero coefficients A, B and C. Else report error.

4. Calculate the value of sin (x) and cos (x) using the series
   i] to a given accuracy ii] using n terms.
   Also print sin (x) and cos (x) value using library function

5. To generate and print prime numbers and perfect dividing numbers up to an integer N. Print also the number of prime and perfect dividing numbers in the series.

6. a] To sort given N numbers in ascending order
   b] To sort given N names in alphabetical order

7. To find the sum, difference and product of two matrices of order MxN and PxQ.

8. a] To find the transpose of given MxN matrix
   b] To find the sum of principle and secondary diagonal elements of the given MxN matrix.

9. To determine if the given matrix of order MxN is symmetric or skew symmetric.

10. To sort the rows of a given MxN matrix.

PART – B

1. To write the sum and difference of 2 clock times (hr: min: sec)
   a] using member functions
   b] using operator overloading
   c] using Friend function
   d] using operator overloading friend function

2. To find sum, difference, product and division of two complex numbers.
   a] using member functions
   b] using operator overloading
   c] using friend function
   d] using operator overloading friend function
3. Program to demonstrate exception handling mechanism while divide by zero.

4. Program to demonstrate generic programming for sorting using
   a] **c**lass templates b] function templates

5. a] Write a C++ program to create a class to handle student marks record, include name, roll number, marks in 3 subjects, total and result as data members and write member function to create new records, display records, sort according to name or total, edit record, add record, delete record and search record.
   b] Write the above program using inheritance

6. Write a C++ program to create a class to handle telephone directory, include name, phone number (landline, mobile), STD/ISD code, City and Country as data members and write member function to create new directory, display directory, sort according to name, edit, add, delete and search as per name/telephone number.

(All programs shall be executed)

ELS 107: SIGNALS AND SYSTEMS

Total No. Hours:42
Credits:2

Unit 1 **09 hours**

Introduction: Definitions of a signal, classification of signals, basic operations on signals, elementary signals, discrete time signals, sampling process and Nyquist rate.

Definition of a system, systems viewed as interconnections of operations, properties of systems.

Unit 2 **12 hours**

Time-domain representations for LTI systems: convolution integral and convolution sum and their properties, properties of LTI systems, impulse and step response**,** differential and difference equation representations and their block diagram representations.

Unit 3 **12 hours**

Fourier series representation for signals: Introduction, discrete time and continuous time Fourier series and their properties, problems.

Discrete and continuous time Fourier transforms and their properties. Parseval's relationship, time-bandwidth product, duality property.

Unit 4 **09 hours**

Laplace Transform: The Laplace transform, unilateral Laplace transform and its inversion, properties, solving differential equations, properties of bilateral Laplace transform and ROC, inversion of bilateral Laplace transform, analysis of LTI systems using Laplace transforms, transfer function, causality and stability, frequency response from poles and zeros.

References:

1. Signals and Systems: Simon Haykin, Barry Van Veen, John Wiley India, 2nd Edn, 2008.
2. Signals and systems: Alan V Oppenheim, Alan S Willsky and Hamid Nawab, **,**PHI, 2nd edition, 2002.

ELC 201: ADVANCED MICROPROCESSORS & ASSEMBLY LANGUAGE PROGRAMMING

Total No. Hours:52
Credits:4

Unit 1 **15 hours**

8086Architecture and programming: 8086 Architecture and programming model, pin description, registers, flags, interfacing of memory RAM and EPROM.

Hardware features of 8086: Bus buffering, latching, timing diagrams, wait state, MIN/MAX modes of operation.

Addressing modes: Immediate addressing, register addressing, memory addressing, base indexed addressing with displacement as the general memory addressing mode, I/O port addressing.

Unit 2 **12 hours**

Programming the 8086: Instruction template for 8086 instructions, code generation using template.

Data Transfer Instruction: Move date to register/memory from register/memory/immediate data, data transfer between a segment register and register/memory, PUSH and POP, exchange, data transfer with I/O ports.

Data Conversion instructions: XLAT, LEA, LDS, LES, LAHF and SAHF instructions.

Arithmetic Instructions: Add, subtract, negate, compare, CBW, CWD, multiply and divide instructions.

Logical Instructions: AND, OR, EX-OR, Test, NOT, ROTATE and shift instructions.

Process Control Instructions: Instructions to set/reset flags, halt, wait, lock, prefix and escape to co-processor instructions.

String Instructions: CMPS, MOVS, LODS, STOS, and SCAS instructions.

Branch Instructions: JMP, conditional jump, LOOP, LOOPE, LOOPNE, JCXZ, CALL, RET.

IBM-PC assembly language programming: Assembly language programming. examples, subroutines and macros, examples.

Unit 3 **12 hours**

Interrupts of 8086: Hardware interrupt, software interrupt and exception, priority of interrupts, 8259A priority interrupts controller (block diagram and its operational description).

BIOS and DOS Services: Binary search, print screen operation, check for password, and rename a file C-language programs using BIOS and DOS services: create sub-directory, get file attributes, control of display on CRT

Direct memory accessing, DMA controller operation

8087 Coprocessor: Overview of 8087 arithmetic coprocessor, pin description, data types, programmer's view, overview of 8087 instruction set.

Unit 4 **13 hours**

Introduction to advanced microprocessors: Computer system overview- advances in computer architectures, RISC and CISC, generations. Introduction to 80286, 80386, 80486, 80586, Pentium and recent advances in microprocessor architecture, real mode and protected mode operation. Concepts of Parallel processing and multi core technology.

Computer buses- System bus - ISA, EISA. Peripheral bus - RS232, SCSI, USB, PCI

References:

1. Microprocessors and Interfacing: Douglas V.Hall, TMH 3rd Edition.
2. Advanced Microprocessors and IBM-PC Assembly Language Programming: Dr.K.Udayakumar, B.S.Umashankar, TMH,2012
3. Advanced Microprocessors and Peripherals, Architecture, Programming and Interfacing : Ray Bhurchandi, Tata McGraw Hill,3rd Edition
4. 8088/8086 Processors Programming, Interfacing, Software, Hardware and applications: Walter A.Triebel and Avatar Singh, PHI,3rd Edition .
5. Intel Microprocessors, Architecture, Programming and Interfacing : Barry B Bray, Pearson Prentice Hall,8th Edition.

ELC 202: MICROWAVE DEVICES AND CIRCUITS

Total No. Hours:52

Credits:4

Unit 1 **10 hours**

Introduction:

Motion of an electron in an electric field and magnetic fields. Review of Gauss's law, Laplace's equation, Faraday's law and Ampere's law. Maxwell's equations, boundary conditions, Poynting's energy theorem.

Unit 2 **14 hours**

Introduction to microwaves:

Microwave frequency bands, microwave transmission lines - transmission line equations and solutions, reflection and transmission coefficients, standing waves and standing wave ratio, line impedance and admittance, Smith chart, impedance matching – single stub and double stub matching.

Microwave waveguides and components:

Rectangular waveguides, TE and TM modes, power transmission and power losses, excitation of modes in rectangular waveguides. Circular waveguides, possible modes, power transmission and power losses, co-axial waveguides. Microwave cavities – rectangular and circular cavity resonators, resonant cavities, Q factor of a cavity resonator. Waveguide tees, magic tee, hybrid ring, waveguide corners, bends and twists, two-hole directional coupler, hybrid coupler, microwave circulators and isolators.

Unit 3 **15 hours**

Microwave tubes:

High frequency limitation of conventional vacuum tubes, Klystron, multicavity klystron amplifier, helix and coupled cavity TWT, cylindrical magnetron – construction, principle of operation, performance characteristics and applications.

Microwave solid state devices and circuits:

Principle, structure, construction and working of Gunn diodes, modes of operation, LSA diode, READ diode, IMPATT, TRAPATT and BARRIT diode, HEMT, tunnel diodes, parametric devices.

Unit 4 **08 hours**

Strip lines and MICs:

Characteristic impedance of microstrip lines, losses and Q-factor of micro strip lines, parallel strip lines, distributed parameters, characteristic impedance and attenuation losses, coplanar and shielded strip lines.

Detection and measurement:

Crystal detectors, slotted line measurements, measurement of VSWR, frequency power and impedance.

Unit 5 **05 hours**

Applications of microwaves: Radar systems, radar equation, duplexer, pulsed radar, CW Doppler radar, FMCW radar. Industrial applications of microwaves.

Microwave radiation hazards: HERP, HERO, radiation hazard limits, radiation protection.

References:

1. Microwave Devices and Circuits: Liao Samuel Y, PHI, 3rd edition
2. Solid state electronic devices: Streetman Ben G, PHI, 3rd edition.
3. Introduction to Electrodynamics: Griffiths D J, PHI, 4th edition.
4. Microwave engineering: Annapurna Das, Sisir Das, TMH, 9th edition.
5. Microwaves: David M Pozar, Wiley 3rd edition.
6. Electronic communication systems: Kennedy, TMH, 4th edition.
7. Foundations of microwave engineering: Robert E Collin,Wiley, 2nd edn.
8. Microwave engineering: Chatterjee R., PHI.

ELC 203: DIGITAL ELECTRONICS AND VHDL

Total No. Hours:52

Credits:4

Unit 1 **12 hours**

Digital circuit analysis and design: Review of Boolean algebra, Karnaugh map and tabulation procedure for minimization of Boolean expression, prime implicant charts, design with basic logic gates. Review of TTL and COMS logic families.

Combinational logic design: Code converters, encoders, decoders, multiplexers, de-multiplexers, implementation of combinational logic using decoders/ multiplexers.

Unit 2 **14 hours**

Asynchronous sequential logic: Ripple (Asynchronous) counters, design of mod N ripple counters using filp-flops, IC 7493, IC 7492, IC 7490.

Synthesis of synchronous sequential circuits: State diagram and state assignments: Binary counters, shift registers, ring counter, Johnson counter, serial adder, sequence detector, serial parity bit generator, PRBS generators.

Noise considerations: Noise types and control methods, shielding, grounding and decoupling, cross talk, transmission line reflections.

Unit 3 **18 hours**

Introduction to VHDL: VHDL terms, describing hardware in VHDL, entity, architectures, concurrent signal assignment, event scheduling, statement concurrency, structural designs, sequential behavior, process statements, process declarative region, process statement region, process execution, sequential statements, architecture selection, configuration statements, power of configurations.

Behavioral Modeling: Introduction to behavioral modeling, inertial delay, transport delay, inertial delay model, transport delay model, transport vs inertial delay, simulation delta drivers, driver creation, generics, block statements, guarded blocks.

Sequential Processing: Process statement, sensitivity list, signal assignment vs variable assignment, Mux example, sequential statements, IF, CASE, LOOP, NEXT,, EXIT and ASSERT statements, assertion BNF, WAIT ON signal, WAIT UNTIL expression, WAIT FOR time expression, multiple wait conditions, WAIT Time-Out, Sensitivity List vs WAIT Statement Concurrent Assignment, Passive Processes.

Unit 4 **8 hours**

Data types: Object types- signal, variable, constant, Data types- scalar types, composite types, incomplete types, file types, File Type caveats, subtypes.

Subprograms and Packages: Subprograms, functions, conversion functions, resolution functions, procedures, packages, package declaration, deferred constants, subprogram declaration, package body and predefined attributes.

References:

1. Digital logic and computer design: M Morris Mano-PHI.
2. Switching and finite automata theory: Z V Kohavi, 2nd Edn-TMH.
3. VHDL, Programming by Example: Douglas L. Perry, 4th Edn.-TMH.
4. Modern digital electronics: R P Jain, 2nd Edn TMH.
5. Introduction to system design using ICs: B S Sonde- Willy Eastern Ltd.
6. Design with TTL ICs: Robert L Morris.
7. VHDL, Primer: J Bhasker, 3rd Edn- Pearson Education.

ELC 204: INSTRUMENTATION AND MICROCONTROLLERS

Total No. Hours:52

Credits:4

Unit 1 **10 hours**

Basic concepts of measurement:

Instrumentation system configuration, problem analysis, errors, static characteristics of a measurement system, calibration. Classification of an instrumentation system according to transfer function, examples, dynamic characteristics of systems.

Unit 2 **12 hours**

Transducers:

Basic requirements of transducers, transducers used in displacement, strain, pressure, temperature, flow, vibration and force measurements.

Unit 3 **8 hours**

Data acquisition systems:

Block diagram, brief description of preamplifier, signal conditioner, instrumentation amplifier, waveform generator, A/D and D/A converter blocks, computer controlled test and measurement system with examples.

Unit 4 **7 hours**

Bio-medical instrumentation:

Origin of bio-electric signals, electrodes for ECG, EEG, and EMG, block diagram of ECG and EEG systems, brief analysis of graphs.

Unit 5 **15 hours**

Microcontrollers:

Introduction, different types of microcontrollers, embedded microcontrollers, processor architectures. Harvard vs. Princeton, CISC vs. RISC architectures, microcontroller memory types, microcontroller features, clocking, I/O pins, interrupts, timers, peripherals.

PIC16F887microcontroller

Core features, pin diagram, device overview, memory organization, I/O Ports, oscillator module, Timer0, Timer1 and Timer2 Module, Comparator module, Analog-to-Digital converter (ADC) module, data EEPROM and flash program memory control, enhanced capture/compare/PWM module , EUSART, master synchronous serial port (MSSP) module, special features of the CPU, instruction set, addressing modes.

References

1. Instrumentation devices and systems: Rangan, Sarma, Mani, TMH
2. Microchip PIC16F87X datasheet
3. Instrumentation measurement and analysis: Nakra B C, Chaudry K K, TMH
4. Handbook of biomedical instrumentation: Khandpur R S, TMH
5. Measurement systems applications and design: Doeblin E O, McGraw Hill, 1990.
6. Electron measurements and instrumentation techniques: Cooper W D and Helfric A D, PHI, 1989.
7. Biomedical instrumentation and measurements: Leslie-Cromwell, Fred J Weibell, Erich A Pfieffer, PHI, 1994.
8. Mechatronics – principles and applications, Godfrey C Onwubolu, Elsevier, 2006.

ELC 205P: ASSEMBLY LANGUAGE PROGRAMMING (8086) AND INTERFACING WITH PIC MICROCONTROLLER LAB

Credits:4

PART-A
ASSEMBLY LANGUAGE PROGRAMMING (8086)

1. Addition, subtraction, multiplication and division of 8-bit, 16-bit binary and decimal numbers.
2. Addition and subtraction of two 24-bit binary and decimal numbers.
3. Average of N- 8-bit/16-bit binary and decimal numbers.
4. a) To generate the Fibonacci series up to the given limit N and also print number of elements in the series (both binary and decimal)
   b) Minimum and maximum out of N numbers
   c) To sort given N numbers in ascending order
   d) Find the GCD of 2 integer numbers (both binary and decimal)
   e) To calculate factorial of a given number using recursion technique.
5. To generate and print prime numbers and perfect dividing numbers up to a limit N (both binary and decimal). Print also the number of prime and perfect dividing numbers in the series.
6. a) Conversion of array of Binary code to Gray code.
   b) Conversion of array of Gray code to Binary code
7. a) To find the Sum and difference of two matrices of order MxN and PxQ (both binary and decimal)
   b) To find the transpose of given MxN matrix
8. Reverse of an array of numbers, byte and word
9. Display current time using DOS service.
10. Display system date using DOS service.
11. Search for an element using binary search in an array of an 8-bit signed numbers. Array is sorted in ascending order.
12. Check for authentic password, and display suitable message.

(Any 10 experiments shall be performed)

PART-B
INTERFACING WITH PIC MICROCONTROLLER

Note: Programs written using C programming language

1. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control.
2. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface.
3. Display of 4- digit decimal number using the multiplexed 7-segment display interface.
4. To test all the gates of a given IC74XX is good or bad.
5. LCD (2X16) interfacing.
6. Analog to digital conversion using internal ADC and display the result on LCD.
7. Implementation of DC-Volt meter (0-5V) using internal ADC and LCD
8. Digital to Analog conversion using PWM (pulse delay to be implemented using timers).

9. Speed control of DC motor using PWM (pulse delay to be implemented using timers).
10. Interfacing of matrix keyboard (4X4) using change on interrupt feature of.
11. Serial communication between microcontroller and PC.
12. Interfacing of Real Time Clock (DS1307).
13. Interfacing of serial ADC (MCP320x).
14. Traic based Ac voltage controller (using zero crossing detector and interrupt).
15. Interfacing of I^2C Based EEPROM/RAM/Flash.

(Any 10 experiments shall be performed)

ELC 206P: VHDL PROGRAMMING LAB

Credits:4

Part A

1. Logic Gates - AND, OR NOT, NAND, NOR, XOR, XNOR
2. Half – Adder, Half – Subtractor, Full – Adder and Full – Subtractor.
3. Encoder, Priority Encoder and Decoder.
4. Comparator, 4 bit adder
5. Multiplexer and De-Multiplexer
6. Code converters - (a) BCD to Excess-3, (b) Binary to Gray and (c) Gray to Binary.
7. Flip – Flops - RS, JK D & T.
8. Counters - Ring counter, Johnson counter, binary counter, BCD counter
9. Shift register – right shift, left shift.
10. 8- bit ALU.

Part B – Interfacing

1. DAC interfacing : Generate square, sawtooth, triangle and sine wave of different frequencies and amplitudes.
2. Controlling the speed of DC motor and stepper motor.
3. Interfacing the LED & Keyboard.
4. Interfacing the LCD.
5. Interfacing the temperature sensor and displaying it on the 7 segment or LCD display.

ELS 207: VLSI TECHNOLOGY

Total No. Hours: 42
Credits: 2

Unit 1 **10 hours**

Introduction:
Review of microelectronics, Introduction to IC technology, Introduction to MOS technology, basic MOS transistors, enhancement and depletion mode transistor action, nMOS and CMOS fabrication, BiCMOS technology.
Logic design with MOSFETs: MOSFETs as switches, logic circuits in CMOS, transmission gate circuits.
Basic electrical properties of MOS transistor:
I_{ds} versus V_{ds} relationships, aspects of threshold voltage V_t, transconductance

Unit 2 **12 hours**

Basic MOS circuits:
NMOS transistor: pass transistor, inverter transfer characteristics, pull-up to pull-down ratio, Z_{pu} /Z_{pd} for nMOS inverter driven by another NMOS inverter and nMOS inverter driven by one or more pass transistors, alternative forms of pull-up.
CMOS inverter: transfer characteristics, MOS transistor circuit model, latch-up in CMOS circuits. BiCMOS inverters
MOS circuit design fundamentals:
MOS layers, stick diagrams, lambda based rules for NMOS and CMOS process, layout diagrams, examples.

Unit 3 **12 hours**

Basic circuit concepts:
Sheet resistance R_s, R_s concept applied to MOS transistors and inverters, standard unit of capacitance, capacitance calculations, delay unit τ, inverter delays, CMOS inverter delay in terms of rise and fall times, driving large capacitance loads, propagation delays.
Scaling of MOS circuits:
Scaling factors, advantages of scaling, limitations to scaling, scaling of wires and interconnections.

Unit 4 **08 hours**

Subsystem design and layout:
Switch logic, gate logic, design of combinational logic circuits, design of clocked sequential circuits.
Reliability and testing of VLSI circuits:
General concepts, CMOS testing, test generation methods.

References:

1. Basic VLSI design: Douglas A Pucknell, Kamran Eshraghian, PHI, 3rd edition,
2. Introduction to VLSI circuits and systems: John P Uyemura, John Wiley
3. Principals of CMOS VLSI design, Neil H E Weste and David Harris, Addison Wesley, 3rd edition,2004.
4. Microelectronic circuits: Adel S Sedra & Kenneth C Smith, Oxford University press, 5th edition, 2003.
5. Silicon VLSI technology: James D Plummer, Michael D Deal and Peter B Griffin, Prentice Hall, 2000.
6. CMOS digital integrated circuits, Analysis and Design, Sung-Ho(Steve) Kang and Yusuf Leblebici, McGraw Hill, 3rd edition, 2002

ELC 301: DIGITAL SIGNAL PROCESSING

Total no. Hours: 52
Credits: 4

Unit 1 **04 hours**

Review of digital signals and systems: Classification of signals, digitization of analog signals, recovery of analog signals, properties of a DSP system, convolution summation.

Unit 2 **10 hours**

Z-Transform: The Z–transform, properties of ROC, properties of Z– transform, inversion of Z–transform, transfer function, causality and stability, frequency response from poles and zeros, unilateral Z-transform.

Unit 3 **12 hours**

Discrete Fourier Transform (DFT):

Discrete Fourier series, Discrete-time Fourier transform, DFT and its properties, Fast Fourier Transform (FFT), DFT properties of circular convolution, fast convolution by signal segmentation, correlation, circular correlation, DFT property of circular correlation, spectrum analysis. Error sources, spectral windows, power density spectrum, joint time frequency analysis.

Unit 4 **14 hours**

Digital filters:

Introduction to digital filters, FIR digital filters, the moving average digital filter, frequency sampling design method, the window method, the comb filter.

IIR Digital filters:

Design based on prototype analog filters, Butterworth normalized low-pass filter, Chebyshev normalized low-pass filter, impulse invariant design method, bilinear z-transform design method, (sinx)/x digital correction filter.

Unit 5 **08 hours**

Implementation of Discrete -Time Systems: Structures for the Realization of Discrete -Time Systems, Structures for FIR Systems, Structures for IIR Systems.

Quantization and rounding problems:

Representation of numbers, Quantization of the input signal, effects of finite word length on stability and frequency response, arithmetic errors.

Unit 6 **04 hours**

Practical implementation considerations:

Introduction to Programmable DSPs: DigitalSignal-Processing System, Introduction to Programmable Digital Signal Processors, Architecture of P-DSPs, Some simple application programs, Recent trends in DSP system design.

References

1. Digital Signal Processing: Terrell T J and Lik-Kwan Shark, Publisher: Palgrave Macmillan 1996
2. Discrete time signal processing: Alan V, Oppenheim and Ronald W Shafer, 3nd Edition, PHI,2009
3. Digital Signal Processing and Applications with the C6713 and C6416 DSK: Rulph Chassing, John Wiley, 2005.
4. Introduction to Digital Signal Processing- Kur R McGraw Hill, Newyork, 1988.
5. Theory and application of DSP- Rabiner L R and Gold B, PHI, 1975.
6. Digital Signal Processing- Avtar Singh, Srinivasan S, Thomson Publications, 2004.
7. TMS320C6713 Floating-Point Digital Signal Processor, SPRS186L.pdf, December 2001.
8. Digital Signal Processors- Architecture, Programming and Applications: Venkataramani B & Bhaskar M,TMH, 2002

ELC 302: ADVANCED COMMUNICATION SYSTEMS

Total No. Hours:52

Credits:4

Unit 1 **06 hours**

Introduction: Elements of a communication system, classification of signals, information and channel capacity. Review of analog modulation and pulse modulation techniques.

Unit 2 **12 hours**

Digital modulation techniques: Fundamentals of binary ASK, PSK, DPSK and FSK modulation schemes, comparison of digital modulation schemes, M – ary signaling schemes, synchronization methods.

Digital transmission of analog signals: Sampling, sampling theorem, signal distortion in sampling, Nyquist rate, aliasing, quantization of analog signals, the PCM system, delta modulation schemes.

Unit 3 **10 hours**

Multiplexing and multiple access: FDM/FDMA/ multiple access, TDM/ multiple access, comparison of FDMA and TDMA, code division multiple access, space division and polarization multiple access, access algorithms ALOHA. Multiple access techniques for local area networks.

Unit 4 **10 hours**

Source coding for digital data: Source coding theorem, Huffman coding, channel coding theorem, matched filter, matched filter receiver.

Error control codes: Linear block codes, binary cyclic codes, convolution codes.

Unit 5 **14 hours**

Wireless communication: Introduction, 1^{st} and 2^{nd} generation cellular systems. Cellular communication from 1G to 3G and 4G systems, future wireless networks.

Signal fading: Introduction, principals of signal fading, propagation and path loss models.

Introduction to multiple antenna techniques: Concepts in multi-antenna configurations – SISO, SIMO, MISO, MIMO, advantages, multiple transmit and receive antennas, spatial multiplexing, multi user MIMO.

References

1. Digital communication fundamentals and applications- B Sklar, 2nd edition, Prentice Hall, 2001.
2. Electronic communication systems – fundamentals to advanced: Wayne Tomasi, Pearson Education, 5th edition, 2009
3. Wireless communications and networking- Vijay K Garg, Elseiver, 2007.
4. MIMO – OFDM wireless communication with MATLAB, Yong Soo Cho, John Wiley and Sons, IEEE press, 2010.
5. Digital and Analog communication systems- Sam Shanmugam, Wiley Student Edition, 2008 reprint.
6. Data communication- William Schweber, McGraw-Hill, 1988
7. Digital communications- Simon Haykin, Wiley, 1988.

ELC 303 : MODERN CONTROL SYSTEMS

Total No. Hours:52
Credits:4

Unit 1 **12 hours**

Introduction: Introduction to the control system, closed loop control, open loop control, servomechanisms, applications of control theory to non-Engineering fields.

Mathematical models of physical systems: Introduction, differential equation of physical systems, mechanical systems, electrical systems, analogous systems, transfer functions of armature controlled and field controlled servomotors, block diagram algebra, block diagram reduction, signal flow graphs, Mason's gain formula.

Unit 2 **12 hours**

Time response analysis: Introduction, standard test signals, time response of first and second order system subjected to unit step input, time response specifications, steady state error and error constants, types of feedback control systems.

Concept of stability: The concept of stability, necessary conditions stability, Routh's stability criterion, relative stability analysis.

Root locus technique: root locus concepts, construction rules (derivations not required).

Stability analysis in frequency domain: Nyquist stability criterion, Bode plots. Gain Margin and Phase Margin

Unit 3 **14 hours**

State variable analysis and design: Introduction, concepts of state, state variables and state model, state space representation using physical variables, solution of state equations, Laplace transform technique, properties of STM. Concept of Controllability and Observability

Control systems (Introductory aspects only)**:** Introduction, P controller, PD controller, PI controller, PID controller. Compensators: realization of basic lead, lag, lead-lag compensations, cascade compensation in frequency domain, feed back compensation.

Unit 4 **14 hours**

Introduction to digital control systems:

Introduction, Advantages of Digital control systems and applications, sampled data systems, Basic discrete time signals -Quantization –Sampling theorem -Data conversion and Quantization -Sampling process -Mathematical modelling -Data reconstruction and filtering of sampled signals – zero -order hold. The Z-transforms, mapping of s –plane to z –plane. Pulse transfer functions-open loop and closed loop sampled data systems, stability analysis in the z-plane, stability analysis of discrete time systems – Jury stability test. Time response of discrete data systems.

References:

1. Control System Engineering- A J Nagarath and M Gopal, Wiley Eastern , 2nd Edition, 1982.
2. Modern Control Systems- Richard C Dorf, Robert H Bishop, Addison Wesley, 12th Edition, 2010.
3. Control Engineering- Ganesh Rao, Pearson Education India, 2010
4. Modern Control Engineering- K Ogata-PHI – 2nd Edition, 2010
5. Feedback and Control Systems – Schaum's Outline series McGrawHill
6. Automatic Control Systems- Benjamin C Kuo, PHI, 9thEdition, 2009
7. Digital Control Engineering- M Gopal, New Age International, 2003.
8. Discrete Time Control Systems- K. Ogata, PHI/Addison-Wesley Longman Pte. Ltd., India, Delhi, 1995.
9. Digital Control Systems- Benjamin C Kuo, Oxford Univ Press, Inc., 2nd Edition, 1992.

Open Elective Offered by Department Of Electronic Science

ELC 304 : BASICS OF DIGITAL ELECTRONICS AND COMMUNICATION

Total No. Hours:52

Credits:4

Unit 1 **12 hours**

Binary Systems: Introduction to Digital Systems, Number systems, binary number system, Decimal to binary & binary to decimal conversion, representation of binary using hexadecimal

Boolean Algebra and Logic Gates: Basic definitions, operators of Boolean algebra, basic theorems and properties of Boolean algebra, basic gates -AND, OR, NOT, XOR, NAND, NOR - only truth table & gate representation, Boolean functions, canonical or standard forms,

UNIT 2 **14 hours**

Introduction to communication, need for modulation, modulation and demodulation techniques AM, FM and PM (Qualitative Analysis only), Block diagram of AM and FM transmitter and Receiver (Qualitative analysis)

Sampling theorem, channel capacity, PAM, PPM, PWM and PCM, Digital modulation technique ASK, PSK, QPSK (Qualitative Analysis only).

UNIT 3 **14 hours**

Introductory Aspects of Multiplexing And Multiple Accesses: FDM, TDM, FDMA,TDMA,CDMA and OFMDA.

Satellite Communication: Introduction, to Orbit, types of orbits, Block diagram of satellite transponder.

UNIT 4 **12 hours**

Evaluation of Communication: 1^{st} generation, 2^{nd} generation, 3^{rd} generation & 4^{th} generation mobile communication, Basics of cellular communication (GSM, CDMA)-Cell architecture, Base stations, relay stations and principles of communication, Introduction to Bluetooth, Wi-Fi, Wi-Max and LTE network.

REFERENCE BOOKS:

1. Digital Fundamentals -Floyd T L , 7^{th} Edition. (Pearson Education Asia), 2002
2. Digital Logic and Computer Design-M. Morris Mono,4^{th} Edition, Pearson, 2009
3. An Introduction to Analog and Digital Communication- Simon Haykins, Wiley student Edition , 2008.
4. Modern digital and analog Communication systems- B. P. Lathi, 4^{rd} Edition 2009 Oxford University press.
5. Communication Systems-Harold P.E, Stern Samy and A Mahmond,1^{st} international Edition Pearson Edition, 2003
6. Electronic Communication, Dennis Roody and John Coolen, Electronic Communication, 4^{th} Edition, 2008

ELC 305A-P: DIGITAL SIGNAL PROCESSING LAB

Credits:2

1. Discrete time signals: Impulse sequence, step sequence, sinusoidal sequence, periodic sequence.
2. Operation on sequences: Signal addition, multiplication, folding, shifting, implementing all operations, decomposing into even and odd parts, decimation and up-sampling.
3. Linear convolution and cross correlation
4. Solving difference equation
5. Discrete time Fourier transforms
   a. Infinite sequence, finite sequence, periodicity, conjugate symmetry,
   b. Properties of DTFT- linearity, symmetry time shifting, frequency shifting, high density and high resolution.
6. Discrete Fourier series and inverse discrete Fourier series
7. Discrete Fourier transform and inverse discrete Fourier transform
   Properties of DFT, Circular folding, circular shifting, circular symmetry, circular convolution.
   FFT, execution time
8. Overlap-save method, overlap – add method to compute convolution and correlation.
9. z-transforms, inverse z-transforms, pole-zero plot residue method, transfer function
10. Digital filters, IIR Filters - Butterworth filters, Chebyshev filters, FIR filters with windowing.

ELC 305B-P: CONTROL SYSTEMS SIMULATION LAB

Credits:2

1. Modelling of control systems. Block diagram reduction: Given the transfer function of individual blocks, determine the transfer function of the system.
2. Simulation of Step response & impulse response :
   a. Study of 1^{st} and 2^{nd} order system's response with variations in ξ and ω_n.
   b. Study of type0, type1 and type2 systems.
3. Study of effect of addition of simple poles and zeros on the stability and response of a system.
4. Stability analysis of LTI systems using Root locus and determination of different time domain specifications from the plots.
5. Stability analysis of LTI systems using: Bode and Nyquist plots. Determination of different control system specifications from the plots.
6. Determination of PI, PD and PID controller action on first order systems.
7. Evaluation of time domain specifications (steady state error, settling time, percentage peak overshoot), and gain margin, phase margin with additional lead compensator in forward path transfer function.
8. Design of Lead and Lag compensation circuit for the given plant transfer function. Study the step response of the system by simulation.
9. Obtain transfer function of a given system from state variable model and vice versa.
10. State variable analysis of a physical system - obtain step response for the system by simulation.
11. Performance analysis of a discrete time system using simulation tools.
12. Study of closed response of a continuous system with a digital controller and sample and hold circuit by simulation.

ELC 306A-P: COMMUNICATION LAB

Credits:2

Section 1: Hardware experiments (Using discrete components)
To construct and study:

1. Amplitude Modulation(AM) and Demodulation
2. Amplitude Shift Keying (ASK) modulation and Demodulation
3. Frequency Modulation (FM) and Frequency Shift Keying (FSK)
4. Phase Locked Loop (PLL) and Frequency Multiplier
5. Voltage Controlled Oscillator (VCO)
6. Time Division Multiplexing using (TDM)
7. Binary Phase Shift Keying (BPSK)
8. Pulse Width Modulation (PWM)

Section 2: Digital Communication Lab (DCL) Trainer Kit Experiments:

1. Analog signal sampling and reconstruction
2. ASK and FSK modulation and demodulation
3. PSK, DPSK and QPSK Modulation and Demodulation
4. Time Division Multiplexing and De-multiplexing
5. TDM PCM modulation and demodulation
6. Delta / Adaptive Delta Modulation and Demodulation
7. PWM / PPM / PAM modulation and demodulation
8. Data Conditioning and Carrier modulation and demodulation

Minimum of 12 experiments should be conducted and (06) experiments from each section

ELC 306B-P: MICROWAVE AND COMMUNICATION SIMULATION LAB

Credits: 2

Section 1: Microwave Lab Experiments

1. Study the V-I characteristics of Gunn diode
2. To study the Characteristics of Reflex Klystron
3. Determination of the characteristics of Directional Coupler
4. To study the characteristics of the Magic Tee
5. To determine Standing Wave Ratio (SWR) and Reflection Coefficient.
6. To determine the frequency & wavelength in a rectangular waveguide working on TE10 mode.
7. To study the characteristics of Isolators and Circulators
8. To measure the unknown impedance using Smith Chart

Section 2: Digital Communication Simulation Experiments:

1. To study and simulate On Off Keying
2. To study and simulate BASK
3. To study and simulate BFSK
4. To study and simulate BPSK
5. To study and simulate QPSK
6. To study and simulate Pulse Code Modulation
7. To study and simulate QAM
8. To simulate and study the QAM with AWGN fading

Minimum of 12 experiments should be conducted and (06) experiments from each section

ELC 401: EMBEDDED SYSTEM DESIGN

Total No. Hours:52
Credits:4

Unit 1 **14 hours**

Hardware Considerations:
Introduction: Overview, design metrics, processor technology, design technology. Custom single-purpose processors- introduction, RT-level combinational & sequential components, custom single purpose processor design, Optimizing program, FSMD, data path & FSM.
General purpose processors and ASIP's: Basic architecture and operation of general purpose processors, programmer's view, development environment - ASIP's – microcontrollers, DSP and less general ASIP environments.

Unit 2 **14 hours**

Standard processor peripherals: Timers, counters and watchdog timers, applications, UART, PWM application, LCD controller, keypad controllers, stepper motor control, ADC and DAC.
Memory: Different types of ROM & RAM, cache system design
Interfacing: introduction to interfacing, communication basics, basic protocol concepts, interrupts and DMA, arbitration, multilevel bus architectures, communication - serial parallel and wireless protocols, I^2C, CAN, USB, FireWire, parallel and wireless protocols.

Unit 3 **10 hours**

Software Considerations: Basics of real time concepts, bus transfer mechanism, software concepts, system concepts, real time definitions, events and determinism, synchronous and asynchronous events, time loading, real time design issues, examples of real time systems.
the software life cycle: phases of the software life cycle, interrupts: basics - shared data problem, interrupt latency.
Survey of software architecture: round robin, round robin with interrupts, function queues, scheduling, RTOS architecture, selection an architecture.

Unit 4 **14 hours**

Introduction to RTOS : tasks, states, data – semaphores and shared data. More operating system services – message queues, mail boxes and pipes, timer function, events, memory management, interrupt
Basic design using RTOS: Principles, an example, encapsulating semaphores and queues, hard real time scheduling considerations, saving memory, space and power.
Embedded software development tools: Host and target machines, linkers/locators for embedded software.

References:

1. Embedded system Design - Frank Vahid and Tony Givargis, John Wiley, 2002
2. An Embedded Software Primer- David E.Simon, Pearson Education, 1999.
3. Real Time System design and analysis- Phillip A Laplante, PHI, 4th Edition. 2011.

ELC 402: HIGH POWER DEVICES AND NANO ELECTRONICS

Total No. Hours:52

Credits:4

Unit 1 **10 hours**

Fundamental consideration of semiconductor power devices: Recombination and lifetime, carrier transport, single and double injection, meso plasma and second breakdown, thermal instability. **Reverse biased diode:** Avalanche breakdown and multiplication factor, breakdown voltage in abrupt, linear and diffused junctions, depletion layer curvature, surface contouring techniques. **Forward biased diode:** V-I characteristics, reverse recovery, diffused junctions and PIN diodes.

Unit 2 **15 hours**

Power junction FETs: Basic structure and operation, device characteristics, analysis of forward blocking and forward conduction mode. **Power MOSFETs:** Structure and operation, forward block mode, forward conduction mode, switching performance, dv/dt capability, DMOS and VMOS structure. **Special Devices:** Light Triggered Thyristor (LTT), Insulated Gate Bipolar Thyristor (IGBT), Insulated gate rectifier (IGR), MOS controlled Thyristor (MCT), BIMOS devices and SMART power devices. **Fabrication of power devices:** Junction formation, sealed tube and open tube systems, alloying, control of deep levels, ohmic contacts, lead and die attachment, surface passivation, encapsulation and packaging.

Unit 3 **05 hours**

Introduction to Nano Science &Technology: Possible applications of Nano Technology, Top down and Bottom up approach. Quantum confinement – Semiconductors, Quantum wells, Quantum wires, Quantum Dots **Properties of Nanomaterials: Optical:** Absorption, transmission, Photo-luminiscence, Fluoroscence, Phosphorescence, Surface Plasmon Resonance, effect of size of nano particles. **Electrical : C**onduction mechanisms in 3D (Bulk), 2D (Thin film) and Low dimensional systems.

Unit 4 **12 hours**

Growth Techniques & characterization tool: Lithographic & Non lithographic techniques & limitations, Plasma arc discharge sputtering, Evaporation techniques – PVD, CVD, PLD, MBE, Sol-Gel. **Characterization tool:** Resolution Vs Magnification, AFM, SEM, TEM, UV-VIS spectrophotometer, XRD.

Unit 5 **10 hours**

Nano electronics &Nano Sensors: Buckminister fullerene, Carbon Nanotubes -types, Nano diamond, Single Electron Transistor, Molecular machine, Nano –Biometrics. **Nano sensors and applications:** Introduction, Nano sensors, Nano sensors based on resistance, capacitance, optical, acoustic properties. Nano sensors based on quantum size effects, Electro chemical sensors, Smart dust sensors

References:

1. Semiconductor power devices- S K Gandhi, John Wiley, 1977.
2. Introduction to Nano science and Nanotechnology- K K Chattopadhyay and A N Banerjee, 2nd Edition, PHI, 2014
3. Nanotechnology – Principles and practices: Sulabha K Kulkurni, 3rd Edition, Springer, 2015
4. Nano- The Essentials - T Pradeep, TMH, 2nd Edition, 2008
5. Power semiconductors- M. Kubat, Springer verlag, 1984.
6. Modern power devices- B J Baliga, Wiley Inerscience, 1987.
7. Physics of semiconductor devices- S M Sze, 3rd Edition, Wiley Eastern, 2006.
8. Nano Materials- B Viswanathan, Narosa Publications, 2nd Edition, 2011
9. Nanoscience and Technology- V S Murlidharan, A Subramanum, CRC press, 2009
10. Instrumentations and Nanostructures- A S Bhatia, Deep and Deep Publications, 2009

ELE 404A: COMPUTER NETWORKS

Total No. Hours:52
Credits:4

Unit 1 **14 hours**

Introduction to Networks, Categories of Networks, Layered tasks, OSI Model, Layers in OSI model, TCP/IP Suite, Addressing, Switching, Telephone and cable networks for data transmission, Telephone networks, Dial up modem, DSL, Cable TV for data transmission.

Unit 2 **8 hours**

DATA LINK CONTROL: Framing, Flow and error control, Protocols, Noiseless channels and noisy channels, Data link protocols: HDLC.MULTIPLE ACCESSES: Random access, Controlled access, Channelization.

Unit 3 **14 hours**

Wired LAN, Ethernet, IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11,Connecting LANs, Backbone and Virtual LANs, Connecting devices, Back bone Networks, Virtual LANs, Virtual circuit networks: Architecture and Layers of Frame Relay and ATM.

Unit 4 **6 hours**

Network Layer, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6 Transition from Ipv4 to Ipv6, Address mapping – ARP, RARP, BOOTP, DHCP, ICMP, IGMP.

Unit 5 **10 hours**

Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing protocols. Transport layer Process to process Delivery, UDP, TCP, Domain name system, Resolution, Congestion Control – Quality of services (QoS) – Techniques to improve QoS.

References:

1. Data Communication and Networking- B Forouzan, 4th Edtion, TMH 2006.
2. Computer networks- Andrew S. Tanenbaum, David J. Wetherall, prentice hall, 5th Edition, 2011.
3. Introduction to Data communication and Networking- Wayne Tomasi: Pearson education 2007.

ELE 404B: IMAGE PROCESSING

Total No. Hours:52
Credits:4

Unit 1 **8 hours**

Digital Image Fundamental: Elements of Visual Perception, Digital Image Processing, Fundamental Steps in Digital Image Processing, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Unit 2 **16 hours**

Image Enhancement:

Image Enhancement in the Spatial Domain**,** Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing and Shaping using Spatial Filtering.

Image Enhancement in the Frequency Domain, Introduction to the Fourier Transform and the Frequency Domain**,** Smoothing and shaping using Frequency Domain Filtering, Homomorphic Filtering.

Unit 3 **6 hours**

Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images.

Unit 4 **8 hours**

Image Restoration: Model of the Image Degradation/Restoration Process, Restoration in the Presence of Noise Only–Spatial Filtering, Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Geometric Transformations.

Unit 5 **6 hours**

Morphological Image Processing: Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Basic Morphological Algorithm, Extensions to Gray-Scale Images.

Unit 6 **8 hours**

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation, Segmentation by Morphological Watersheds.

References:

1. Digital Image Processing-Rafael C. Gonzalez and Richard E.Woods, Pearson Education, 2nd Edition, 2001.
2. Fundamental of Digital Image Processing- Anil K. Jain, Pearson Education, 2001.
3. Digital Image processing and Analysis- B.Chanda and D. Dutta Majumbar, PHI, 2006

ELE 404C: MEDICAL INSTRUMENTATION SYSTEMS

Total No. Hours: 52

Credits: 4

Unit 1 **7 hours**

Medical Instrumentation Basics: Generalized Systems, Constraints. Classification of Biomedical Instruments, Bio-statistics, Regulation of Medical Devices. Overview of Fiber Optic Sensors, Radiation Sensors, Smart Sensors, Electro Chemical Sensors.

Unit2 **7 hours**

Bioelectric Signals And Electrodes: Electrode- Electrolyte Interface, Polarizable and Nonpolarizable Electrodes, Electrode Model, Recording Electrodes, Internal Electrodes, Micro Electrodes.

Unit 3 **13 hours**

Measurement Systems: Patient Monitoring Systems, Measurement of Blood Pressure, Heart Rate, Pulse Rate, Temperature, Heart Sounds, Blood Flow and Volume, Respiratory Systems, Measurements, Cardiac Output Measurement, Blood pH, pO_2 Measurement, Oximeters, Audiometers, Spectrophotometers.

Unit 4 **10 hours**

Medical Imaging Systems: Information content of an Image, Radiography, Computed Radiography, Computed Tomography, Magnetic Resonance Imaging, Nuclear Medicine, Single Photon Emission Computed Tomography, Positron Emission Tomography, Ultrasonagraphy.

Unit 5 **15 hours**

Therapeutic And Prosthetic Devices: Cardiac Pacemakers, Defibrillators, Hemodialysis, Lithotripsy, Ventilators, Incubators, Drug Delivery devices, Artificial Heart Valves, Heart Lung Machine, Applications of Laser.

Electrical Safety: Physiological Effects of Electricity, Important susceptibility parameters, Distribution of Electric Power. Macroshock Hazards, Microshock Hazards, Electrical safety codes and Standards, Basic Approaches to Protection against shock, Equipment Design, Electrical Safety Analyzers, Testing.

References:

1. Medical Instrumentation application and Design - John G.Webster, Editor, John Wiley & Sons, Inc Noida. 3rd Edition, 2008
2. Handbook of Biomedical Instrumentation - R.S.Khandpur, Tata McGraw Hill, New Delhi, 2nd Edition, 2008
3. Introduction to Biomedical Equipment Technology- Joseph J. Carr and John M. Brown, Pearson Education,4th Edition, 2008.

ELE 404D: ANTENNA THEORY AND DESIGN

Total No. Hours:52
Credits:4

Unit 1 **10 hours**

Antenna Basic Parameters: Types of Antennas, Radiation Mechanism, Current Distribution on a Thin Wire Antenna. **Antenna Parameters:** Radiation Pattern, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Numerical Techniques, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance Antenna Radiation Efficiency, Antenna Vector Effective Length and Equivalent Areas, Maximum Directivity and Maximum Effective Area, Friis Transmission Equation and Radar Range Equation

Unit 2 **12 hours**

Linear Wire Antennas and Arrays, Infinitesimal Dipole, Small Dipole, Region Separation, Finite Length Dipole, Half-Wavelength Dipole Linear Elements Near or on Infinite Perfect Conductors, Ground Effects **Antenna Arrays –** Two element array, N- element linear array : uniform linear amplitude and spacing, N-element linear array: Directivity, Circular array

Unit 3 **10hours**

Microstrip Antennas: Advantages and limitations of Microstrip antennas, radiation mechanism, antenna configurations, Rectangular Patch, Quarter wave rectangular patch, Circular Patch, Quality factor, Bandwidth, and frequency, Input Impedance, Coupling, Circular Polarization. Microstrip feeds – coplanar feed, proximity coupled feed, aperture coupled feed, waveguide feed. Applications - Radar antennas, mobile to satellite and medical applications

Unit 4 **10 hours**

Design considerations of Rectangular Microstrip antennas- Models – transmission line and cavity model, substrate selection, element width and length, radiation pattern and radiation, Loss and Q factor, Bandwidth, Radiation efficiency, feed point location, RCS of a rectangular patch, effects of dielectric, effects of finite size ground plane.

Unit 5 **10 hours**

Smart Antennas: Smart-antenna analogy, Cellular Radio Systems, Signal Propagation, benefits and limitations of smart antennas. Beamforming, Mobile Adhoc Networks, Diversity combining, Rayleigh-Fading, and Trellis-Coded Modulation

References

1. Antenna Theory analysis and design- Constantine Balanis, 3rd Edition, John Wiley, 2005
2. Microstrip antenna design handbook- Ramesh Garg, P Bhatia, I Bahl, A Ittipiboon, Artec House Publications, 1st Edition, 2001
3. Antenna Theory and Design- W. L.Stutzman, and G.A. Thiele, 2nd Edition, John Wiley & Sons, 1998.
4. Antenna Theory and Design- R.S.Elliot, Revised edition, Wiley-IEEE Press, 2007.

ELE 404E: ADVANCED POWER ELECTRONICS

Total No. Hours:52

Credits:4

Unit 1 **15 hours**

Special Power Devices: Thyristor families**,** IGBT Power MOSFET, Power Modules, Smart power devices.

PWM Converters And Applications: Switch-Mode DC-AC Inverters: Basic Concepts - Single Phase Inverters Blanking Time. Single Pulse Modulation of Single Phase Square Wave Inverters - Multi pulse modulation – PWM Principles. Sinusoidal Pulse Width Modulation in Single Phase Inverters - SPWM

Special Inverter Topologies: Current Source Inverter - Ideal Single Phase CSI operation, analysis and waveforms - Analysis of Single Phase Capacitor Commutated CSI - Series Inverters - Analysis of Series Inverters - Modified Series Inverter Three Phase Inverter. . Multilevel Inverters, Cascaded Multilevel inverter, 5-phase PWM Inverter drive.

Unit 2 **7 hours**

Converter and chopper control of dc drives: Analysis of series and separately excited dc motor with single phase and three phase converters – modes of operation – power factor improvement – commutation – analysis of series and separately excited dc motor fed from choppers – chopper based implementation of braking schemes.

Unit3 **7hours**

Control of Induction motor and wound rotor induction motor drive: AC power controller fed induction motor drive – different types - closed loop control – variable frequency operation of three phase induction motors, Torque slip characteristics of wound rotor induction motor – combined stator voltage control and rotor resistance control.

Unit 4 7 **hours**

Concepts of Rotating Machines: Calculation of air gap mmf of a single turn full pitch distributed armature windings - Per phase full pitched and short pitched armature coils (AC machines) - Calculation of air gap mmf of a DC machine - Introduction to direct axis and quadrature axis theory in salient pole machines - Calculation of air gap inductances of a synchronous machine.

Unit 5 **16 hours**

Photovoltaic Energy Conversion:

Solar radiation and measurements - Solar cells – Panels and their characteristics – Influence of insulation and temperature – PV arrays –Maximum power point tracking – Applications – Water pumping – Street lighting – DC-DC converters for solar PV systems**.**

Wind Energy Systems- Basic principle of Wind Energy Conversion System – Nature of Wind – Components of Wind Energy Conversion System –Generators for WECS- Classifications of WECS – Self excited induction generator -Synchronous generator-Power conditioning schemes.

Power Quality Problems: Voltage Sags and Transients-Voltage Sag-Introduction - Definition - characterization: Magnitude, Duration - Causes of Voltage Sag – Three Phase Unbalance - Phase angle jumps - Load influence on voltage sags - Overview of mitigation methods.

Harmonics- Introduction - Definition and terms in Harmonics, Harmonics indices, Inter harmonics, Notching - Voltage Vs Current distortion - Harmonics Vs Transients - Sources and effects of

harmonic distortion - System response characteristics - Principles of controlling harmonics - Standards and limitation - Mitigation and control techniques.

References:

1. Modern Power Electronics and AC Drives-Bimal K. Bose, Pearson Education Asia 2001.
2. Fundamentals of Electrical Drives- Gopal K. Dubey, New Delhi, 2 nd Edition, Narosa Publishing House, 2001.
3. Power Electronics: Converters, Applications and Design- Ned Mohan, Tore M. Undeland and William P.Robbins, New Jersey, John Wiley and Sons, 2003.
4. Design of magnetic components for switched Mode Power converters- Umanand L., Bhat S.R., Wiley Eastern Ltd.,1992.
5. Energy Technology – Non Conventional, Renewable and Conventional- S. Rao and Parulekar, New Delhi, Khanna Publishers, 1999.
6. Wind and Solar Power System- Mukund R. Patel, New York, CRC Press LLC, 1999.
7. Power Electronics: Converters, Applications and Design- Ned Mohan, Tore M. Undeland and William P.Robbins, New Jersey, John Wiley and Sons, 2003.
8. Power Electronics Circuits, Devices and Applications- M.H. Rashid, New Delhi, Prentice Hall of India, 2004.
9. Electrical Power Systems Quality- Dugan, Mark F. McGranaghan and H. Wayne Beaty, NewYork, McGraw-Hill, 2002.

ELE 404F: MULTIMEDIA COMMUNICATION

Total No. Hours:52
Credits:4

Unit 1 **13 hours**

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

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

Unit 2 **13 hours**

Text and image compression: introduction, compression principles, text compression, image compression. 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 3 **13 hours**

Multimedia information networks: Introduction, LANs, Ethernet, Token ring, Bridges, FDDI High-speed LANs, LAN protocol. The internet**:** Introduction, IP Datagrams, Fragmentation, IP Address, ARP and RARP, QoS Support, IPv8.

Unit 4 **6 hours**

Broadband ATM networks: Introduction, Cell format, Switfh and Protocol Architecture ATM LANs.

Unit 5 **7 hours**

Transport protocol: Introduction, TCP/IP, TCP, UDP, RTP and RTCP.

References:

1. Multimedia communications: Applications, Networks, Protocols and Standards, Fred Halsall, pearson education, Asia, 2nd Indian reprint 2002.
2. Multimedia information networking- Nalin K. Sharda, PHI, 2009.
3. Multimedia fundamentals: Volume 1 - media coding and content processing, Ralf Steinmetz, Klara Narstedt, Pearson education, 2004.
4. Multimedia Systems Design, Prabhat K. Andleigh, Kiran Thakrar, PHI, 2004.

ELE404G: SPEECH PROCESSING

Total No. Hours:52
Credits:4

Unit 1 **13 hours**

Mechanics of Speech: Speech production: Mechanism of speech production, Acoustic phonetics – Digital models for speech signals - Representations of speech waveform: Sampling speech signals, basics of quantization, delta modulation, and Differential PCM – Auditory perception: psycho acoustics.

Time Domain Methods for Speech Processing: Time domain parameters of Speech signal – Methods for extracting the parameters, Energy, Average Magnitude, Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function.

Unit 2 **13 hours**

Frequency Domain Method for Speech Processing: Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates - Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis - Analysis synthesis systems: Phase vocoder, Channel Vocoder -Homomorphic speech analysis: Cepstral analysis of Speech, Formant and Pitch Estimation, Homomorphic Vocoders.

Unit 3 **13 hours**

Linear Predictive Analysis of Speech: Basic Principles of linear predictive analysis – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm,– Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

Unit 4 **13 hours**

Application of Speech & Audio Signal Processing : Algorithms: Dynamic time warping, K-means clustering and Vector quantization, Gaussian mixture modeling, hidden Markov modeling - Automatic Speech Recognition Feature Extraction for ASR, Deterministic sequence recognition, Statistical Sequence recognition, Language models - Speaker identification and verification – Voice response system – Speech synthesis: basics of articulatory, source-filter, and concatenative synthesis – VOIP.

References:

1. Discrete-Time Speech Signal Processing- Thomas F, Quatieri, Prentice Hall / Pearson Education, 2004.
2. Speech and Audio Signal Processing- Ben Gold and Nelson Morgan, John Wiley and Sons Inc., Singapore, 2004
3. Digital Processing of Speech signals- L.R.Rabiner and R.W.Schaffer, Prentice Hall-1979
4. Fundamentals of Speech Recognition- L.R. Rabiner and B. H. Juang, Prentice Hall, 1993.
5. Discrete Time Processing of Speech Signals- J.R. Deller, J.H.L. Hansen and J.G. Proakis, John Wiley, IEEE Press, 1999.

ELE 404H: SYSTEM ON CHIP

Total No. Hours:52
Credits:4

Unit 1 **8 hours**

Introduction: System trade offs and evolution of ASIC Technology – System on chip concepts and methodology – SoC design issues – SoC challenges and components.

Unit 2 **10 hours**

Design Methodologic For Logic Cores: SoC Design Flow – On-chip buses – Design process for hard cores – Soft and firm cores – Designing with hard cores, soft cores – Core and SoC design examples.

Unit 3 **11 hours**

Design Methodology For Memory And Analog Cores : Embedded memories – Simulation modes – Specification of analog circuits – A to D converter – D to A converter – Phase-located loops – High speed I/O

Unit 4 **11 hours**

Design Validation : Core level validation – Test benches- SoC design validation – Cosimulation – Hardware/software coverification.

Unit 5 **12 hours**

SOC Testing : SoC Test issues – Testing of digital logic cores – Cores with boundary scan – Test methodology for design resuse – Testing of microprocessor cores – Built in self test method – Testing of embedded memories.

References:

1. System-on-a-chip: Design and Test- Rochit Rajsunah, Artech House, London, 2000
2. System-on-a-chip verification: Methodology and Techniques- Prakash Raslinkar, Peter Paterson & Leena Singh, Kluwer Academic Publishers, 2003.
3. System on Chip Test Architectures: Nanometer Design for Testability- Lavng-Testing Wang, Charles E Strout and NurATouba, Morgan Kaufmann, 2007.

ELE 404I: WAVELET TRANSFORMS

Total No. Hours:52
Credits:4

Unit 1 **13 hours**

Continuous Wavelet Transform: Introduction, C-T wavelets, Definition of CWT, The CWT as a correlation. Constant Q-Factor Filtering Interpolation and time frequency resolution, the CWT as an operator, inverse CWT..

Introduction to Discrete Wavelet Transform And Orthogonal Wavelet Decomposition: Introduction. Approximation of vectors in nested linear vector spaces, (i) example of approximating vectors in nested subspaces of a finite dimensional liner vector space, (ii)Example of approximating vectors in nested subspaces of an infinite dimensional linear vector space. Example MRA. (i) Bases for the approximations subspaces and Harr scaling function,(ii) Bases for detail subspaces and Haar wavelet.

Unit 2 **13 hours**

MRA, Ortho Normal Wavelets And Their Relationship To Filter Banks: Introduction, Formal definition of an MRA. Construction of a general orthonormal MRA, (i) scaling function and subspaces, (ii) Implication of dilation equation and orthogonality, a wavelet basis for MRA. (i) Two scale relations for (t), (ii) Basis for the detail subspace (iii) Direct sum decomposition, Digital filtering interpolation (i) Decomposition filters, (ii) reconstruction, the signal.

Examples of Wavelets: Examples of orthogonal basis generating wavelets, (i) Daubechies D_4 scaling function and wavelet. (ii) band limited wavelets, Interpreting orthonormal MRAs for Discrete time MRA, (iii) Basis functions for DTWT.

Unit 3 **8 hours**

Alternative Wavelet Representations: Introduction, Bi-orthogonal wavelet bases, Filtering relationship for bi-orthogonal filters, Examples of bi-orthogonal scaling functions and wavelets. 2-D wavelets..

Unit 4 **12 hours**

Non-separable multidimensional wavelets, wavelet packets. Wavelets Transform and Data Compression: Introduction, transform coding, DTWT for image compression (i) Image compression using DTWT and run-length encoding.(i) embedded tree image coding (ii) compression with JPEG audio compression (iii) audiomasking, (iv) wavelet based audio coding.

Unit 5 **6 hours**

Construction Of Simple Wavelets: Construction of simple wavelets like Harr and DB1., **Other Applications of Wavelet Transforms:** Introduction, wavelet de-noising, speckle removal, edge detection and object isolation, Image fusions, Object detection by wavelet transforms of projections.

References:

1. Wavelet transforms- Introduction to theory and applications- Raghuveer M.Raoand Ajit S. Bapardikar, Pearson Education, 2000.
2. Wavelet transforms- Prasad and Iyengar, Wiley estern, 2001.
3. Wave-let and filter banks- Gilbert Strang and Nguyen Wellesley Cambridge press, 1996.

ELE 404J: WIRELESS COMMUNICATION

Total No. Hours:52
Credits:4

Unit 1 **10 hours**

Introduction: A basic cellular system, performance criteria, operation of cellular systems, planning a cellular system, analog & digital cellular systems. Examples of Wireless Communication Systems: Paging Systems, Cordless Telephone Systems, Cellular Telephone Systems. Bluetooth and ZigBee.

Unit 2 **8 hours**

Elements of Cellular Radio Systems Design: General description of the problem, concept of frequency reuse channels, co-channel interference reduction factor, desired C/I from a normal case in an omnidirectional antenna system, cell splitting, consideration of the components of cellular systems.

Unit 3 **10 hours**

Digital Communication through fading multipath channels: Fading channel and their characteristics- Channel modeling, Digital signaling over a frequency non selective slowly fading channel. Concept of diversity branches and signal paths. Combining methods: Selective diversity combining, Switched combining, maximal ratio combining, Equal gain combining.

Unit 4 **10 hours**

Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, Channel model and SNR performance, OFDM Issues – PAPR, Frequency and Timing Offset Issues. Introduction to MIMO, MIMO Channel Capacity, SVD and Eigen modes of the MIMO Channel, MIMO Spatial Multiplexing – BLAST, MIMO Diversity – Alamouti, OSTBC, MRT, MIMO - OFDM

Unit 5 **14 hours**

Wireless Systems & Standards: AMPS and ETACS, United states digital cellular (IS- 54 & IS 136), Global system for Mobile (GSM): Services, Features, System Architecture, and Channel Types, Frame Structure for GSM, Speech Processing in GSM, GPRS/EDGE specifications and features. 3G systems: UMTS & CDMA 2000 standards and specifications. CDMA Digital standard (IS 95): Frequency and Channel specifications, Forward CDMA Channel, Reverse CDMA Channel, Wireless Cable Television, Long Term Evolution (LTE).
Future trends: 4G mobile techniques, LTE-Advance systems

References:

1. Wireless Communications: Principles and Practice- T. S. Rappaport, 2nd Edition, Pearson Education Asia, 2010.
2. Mobile Cellular Telecommunications- William C Y Lee, 2nd Edition, MGH, 2004.
3. Mobile and Personal Communication systems and services- Raj Pandya, Prentice Hall of India, 2001.
4. MIMO Wireless Communications- Ezio Biglieri, Cambridge University Press, 2007
5. Wireless and Digital Communications- Dr. Kamilo Feher, Prentice-Hall PTR, 1995

ELE 404K: ARM PROCESSORS AND REAL-TIME OPERATING SYSTEMS

Total No. Hours:52
Credits:4

Unit 1 **10 hours**

Introduction: Introduction to embedded systems, ARM embedded system, ARM processor fundamentals: Registers, Current program status register, pipeline, exceptions, Interrupts, the Vector table, Core extensions, ARM processor families.

ARM Instruction Set: Introduction to ARM instruction set: Data processing instructions, Branch instructions, load-store instructions, software interrupt instructions, program status register instructions, and Coprocessor instructions.

Unit 2 **10 hours**

Thumb Instruction Set and Programming: Introduction to thumb instruction set Thumb programmer's model, Thumb branch instructions, data processing instructions, Single register load-store Instructions, Multiple-Register load-store instruction, Stack instruction, Software interrupts instruction, ARM assembly language Programming.

Architectural Support for High-Level languages: Data types, Floating-point data types, The ARM floating point architecture, Expressions, Conditional statements, Loops, functions and procedures.

Unit 3 **13 hours**

Real Time Operating Systems: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS. POSIX standards. RTOS Issues - Selecting a Real Time Operating System, RTOS comparative study

Vx Works Memory Management: Vx works and Tornodo, Features of IDE – Host Target Architecture – Project Management – Thread Scheduling algorithm – Inter task communication using shared memory – Pipes – Message, Queres – Semaphores – Mutual exclusion

Unit 4 **7 hours**

File Formats Of Vx Works: Hardware and software interrupt handling – RAM Disk – File systems – Using DOS file systems on RAM disks – I/O systems – Memory Management – WDT – Message logging – Overview of networking on Vx Works – Managing host table – Managing IP

Unit 5 **12 hours**

Socket Programming : Address – Sockets – Accessing remote files using FTP, TFTP, RSH and NSF – configuring Vx Works as FTP server and FTP client – TFTP server and client – NFS server and NFS client – NFS Client Rlogin – Using Crosswind for Debugging – Using Wind View as a Runtime Analyzer – Using Browser and Winds, Using Integrated Simulator – Building Vx Works image – Creating a Boot image – Download and Booting Vx Works on the Target system

References:

1. ARM system developer's guide- Andrew N Sloss, Dominic Symes and Chris Wright, Elsevier, Morgan Kaufman publishers, 2008.
2. Embedded Real-Time Systems: Concepts, Design and Programming The Ultimate Reference- Prasad K.V.K.K, DREAMTECH PRESS, NEW DELHI,2003
3. VxWorks Programmers Gide
4. VxWorks Reference Manual
5. Real-Time Systems Design and Analysis- Phillip. A. Laplante, 2nd Edition, PHI, 2005.